communications

PROGRESS LINE

144-174 MEGACYCLE
25- and 50-Watt

AC MOBILE COMBINATIONS FI-33 & FI-36
and
MI-33-E & MI-36-E (ISSUE 3)

EBI-41693B

CUSTOMER ORDER NO. 31740
G. E. REQUISITION NO. X102 3141
Item 33

General Installation

Transmitter

Receiver

Power Supply

Control Equip.

Access. and Misc.

INSTRUCTIONS
for

PROGRESS LINE

144-174 MEGACYCLE
25- and 50-Watt

AC MOBILE COMBINATIONS FI-33 & FI-36
and
MI-33-E & MI-36-E (ISSUE 3)

EBI-41693B

2-WAY MOBILE RADIO

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC
LYNCHBURG, VIRGINIA

$2.50 per copy

Printed in U.S.A.

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GENERAL INFORMATION EBI-4848
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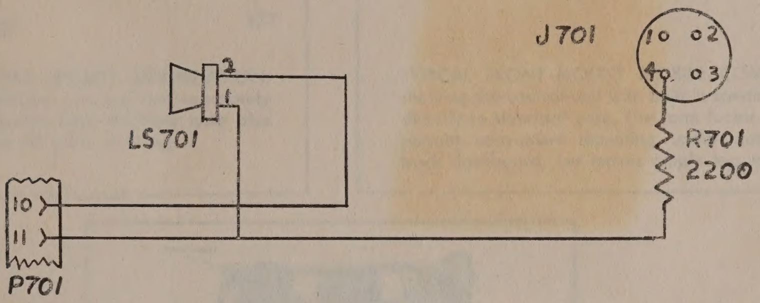
Requisition X102-3141
Item Number 33

ADDENDUM TO EBI-41693

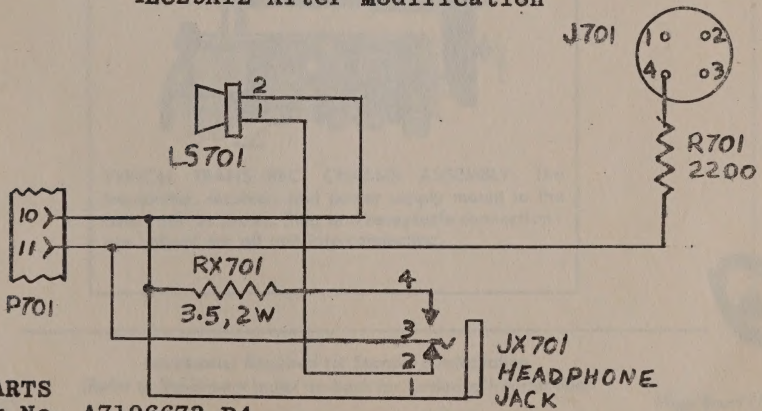
The FI33 AC Mobile Combinations for this requisition are standard except for a Special Front-Mount Control Unit, Model 4EC29A12.

The 4EC29A12 is modified to provide a headphone output jack. When a headphone is plugged in, the speaker is disabled (see sketch below for circuit modifications). The two-frequency switch marking on the control unit has been changed from A and B to CHAN 1 and CHAN 2.

4EC29A12 Before Modification


J701
1
2
3
4
R701
2200
LS701
2
1
10
11
P701

4EC29A12 After Modification


J701
1
2
3
4
R701
2200
LS701
2
1
10
11
P701
RX701
3.5, 2W
4
3
2
1
JX701
HEADPHONE
JACK

SPECIAL PARTS
JX701 Dwg No. A7106673-P4
RX701 Dwg No. K7131424-P1

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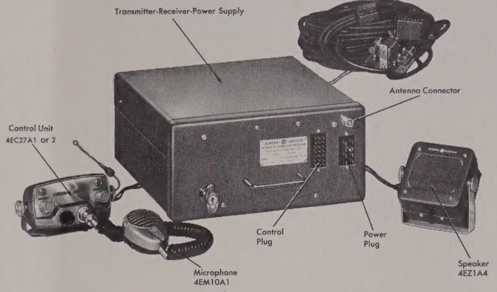
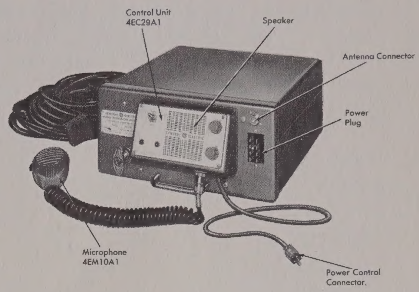
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

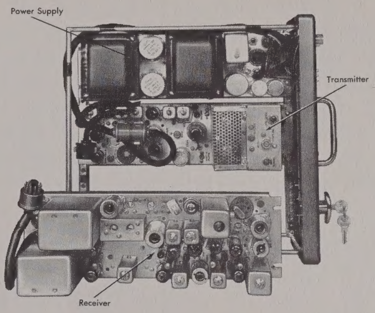
PROGRESS LINE MOBILE COMBINATIONS


Transmitter-Receiver-Power Supply
Antenna Connector
Control Unit
4EC27A1 or 2
Control
Plug
Power
Plug
Speaker
4EZ1A4
Microphone
4EM10A1

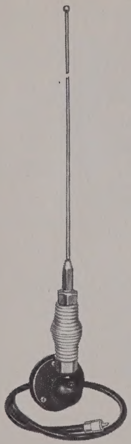
TYPICAL TRUNK-MOUNT MOBILE COMBINATION. The control-unit and speaker are mounted separately from the case. The drawer-type standard case also has a removable cover for easy servicing.


Control Unit
4EC29A1
Speaker
Antenna Connector
Power
Plug
Microphone
4EM10A1
Power Control
Connector.

TYPICAL FRONT-MOUNT MOBILE COMBINATION, showing the control-unit with built-in speaker attached directly to standard case. The form factor of this case permits convenient mounting under automobile or truck dashboard, yet leaves ample leg room.


Power Supply
Transmitter
Receiver

TYPICAL TRANS.-REC. CHASSIS ASSEMBLY. The transmitter, receiver, and power supply mount to the case rack as shown. Plug and receptacle connections are utilized for all unit interconnecting.



Low Band (25-54 MC)
Mobile Antenna

High Band (144-174 MC)
Mobile Antenna

Accessories Required for Standard Installation
(Refer to Equipment Index on back for Ordering Information)

Trunk Mount	*Front Mount*
Control Cable	Power Cable
Power Cable	Power Control Cable
Relay Assembly	Relay Assembly
Circuit Breakers	Circuit Breakers

EQUIPMENT INDEX

25-54 Megacycle Low Band Combinations				Equipment	144-174 Megacycle High Band Combinations		
Series 12	Series 13	Series 16	Series 17		Series 32	Series 33	Series 36
1	1	1	1	**1.** 14″ Case PL-7774394-G11	1	1	1
				2. Transmitter a) 25-54 Megacycles 1) City Power and Medium Power 4ET22A1(25-30 Mc, 1-Freq) 4ET22A2 (30-42 Mc, 1-Freq) 4ET22A3 (40-54 Mc, 1-Freq) 4ET22A11 (25-30 Mc, 2-Freq) 4ET22A12 (30-42 Mc, 2-Freq) 4ET22A13 (40-54 Mc, 2-Freq)			
		1	1	2) High Power and Super Power 4ET23A1 (25-30 Mc, 1-Freq) 4ET23A2 (30-42 Mc, 1-Freq) 4ET23A3 (40-54 Mc, 1-Freq) 4ET23A11 (25-30 Mc, 2-Freq) 4ET23A12 (30-42 Mc, 2-Freq) 4ET23A13 (40-54 Mc, 2-Freq)			
				b) 144-174 Megacycles			
				1) City Power and Medium Power 4ET20A1 (144-152 Mc, 1-Freq) 4ET20A2 (152-174 Mc, 1-Freq) 4ET20A11 (144-152 Mc, 2-Freq) 4ET20A12 (152-174 Mc, 2-Freq)	1	1	
				2) High Power 4ET21A1 (144-152 Mc, 1-Freq) 4ET21A2 (152-174 Mc, 1-Freq) 4ET21A11 (144-152 Mc, 2-Freq 4ET21A12 (152-174 Mc, 2-Freq)			
				3. Receiver			
1	1	1	1	a) 25-54 Megacycles 1) Narrow Band (20-kc channels) 4ER24A1 or C (25-30 Mc, 1-Freq) 4ER24A2 or C (30-54 Mc, 1-Freq) 4ER24A11 or C (25-30 Mc, 2-Freq) 4ER24A12 or C (30-54 Mc, 2-Freq) 2) Wide Band (40-kc channels) 4ER24B1 or D (25-30 Mc, 1-Freq) 4ER24B2 or D (30-54 Mc, 1-Freq) 4ER24B11 or D (25-30 Mc, 2-Freq) 4ER24B12 or D (30-54 Mc, 2-Freq)			
				b) 144-174 Megacycles, 1) Narrow Band (30-kc channels) 4ER25A1 (144-152 Mc, 1-Freq) 4ER25A2 (152-174 Mc, 1-Freq) 4ER25A11 (144-152 Mc, 2-Freq) 4ER25A12 (152-174 Mc, 2-Freq) 2) Wide Band (60-kc channels) 4ER25B1 (144-152 Mc, 1-Freq) 4ER25B2 (152-174 Mc, 1-Freq) 4ER25B11 (144-152 Mc, 2-Freq) 4ER25B12 (152-174 Mc, 2-Freq)			
				4. Power Supplies			
1				a) City Power 6/12-Volt Vibrator Supply 4EP2L1	1		
	1			b) Medium Power 1) 6/12-Volt Vibrator Supply 4EP2A1 2) 6/12-Volt Dynamotor Supply 4EP2C1 (Low-Band only) 3) 12-Volt Dynamotor Supply 4EP2K1 4) 24-Volt Vibrator Supply 4EP2M1 5) 117-Volt AC Supply 4EP2E1		1	
		1		c) High Power 1) 6/12-Volt Vibrator Supply 4EP2B1 2) 6/12-Volt Dynamotor Supply 4EP2C1 3) 117-Volt AC Supply 4EP2F1			1
			1	d) Super Power (Low Band only) 6/12-Volt Dynamotor Supply 4EP2D1			
1	1	1	1	**5.** Control Unit a) 4EC27A1 or 2—for trunk mount b) 4EC29A1—for front mount c) 4EC31A1—for extended-local control (available only on MI combinations)	1	1	1
2	2 Note A	2 Note A	2	**6.** Cables (Power Cable req'd. for all combinations. Control Cable req'd for trunk mount only. Power Control Cable req'd for front mount mobile only) a) PL-7145250-G1—front mount Power Control Cable b) PL-7145251-G1—AC mobile power cable c) PL-7147299-G1—trunk mount 6-volt power cable (17′) d) PL-7147299-G2—front mount 6-volt power cable (9′) e) PL-7147299-G9—trunk mount 12-volt power cable (17′) f) PL-7147299-G10—front mount 12-volt power cable (9′) g) PL-7147299-G8—trunk-mount 24-volt cable (17′) h) PL-7487964-G1, 2 or 4—trunk mount control cable (17′) i) PL-7489266-G1—control cable for extended-local control (23′) Note A—only 1 cable required for AC Mobile	2	2 Note A	2 Note A
1	1	1	1	**7.** Relay Assembly (not required for 117-volt, a-c operation) a) PL-7487952-G6—6-volt assembly b) PL-7487952-G9—12-volt assembly c) PL-7487952-G8—24-volt assembly	1	1	1
2	2	2	2	**8.** Circuit Breakers (not required for 117-volt a-c operation) a) 6-Volt City Power Circuit Breaker (20A) 5491516-P4 Circuit Breaker (15A) 5491516-P3 Medium Power Circuit Breaker (30A) 5491516-P6 Circuit Breaker (15A) 5491516-P3 High Power Circuit Breaker (50A) 5491516-P8 Circuit Breaker (15A) 5491516-P3 Super Power (Low-Band only) PS Fuse (60 A) A-7142444-P11 Circuit Breaker (15A) 549151-P3 b) 12-Volt City Power Circuit Breaker (12A) 5491516-P2 Circuit Breaker (12A) 5491516-P2 Medium Power Circuit Breaker (20A) 5491516-P4 Circuit Breaker (12A) 5491516-P2 High Power Circuit Breaker (25A) 5491516-P5 Circuit Breaker (12A) 5491516-P2 Super Power (Low-Band only) Circuit Breaker (30A) 5491516-P6 Circuit Breaker (12A) 5491516-P2 c) 24-Volt Medium Power Circuit Breaker (10A) 5491516-P1	2	2	2
1	1	1	1	**9.** Antenna (for mobile combinations) a) Low Band 1) Base Assembly PL-7472880-G5 2) Spring Adapter PL-7476632-G3 3) Antenna Rod PL-7491074-P1 4) Antenna Coil (25-30 Mc only) 4KY9A1 5) Antenna Cable (a) 5-foot trunk-mount cable PL-7474980-G6 or (b) 12-foot front-mount cable PL-7474980-G7 b) High Band 4EY12A10 (includes cable)	1	1	1
1	1	1	1	**10.** Transmitter-to-Receiver Antenna Cable a) B-7488600-P24 (for 14″ case) b) B-7488600-P25 (for 17″ case)	1	1	1
1	1	1	1	**11.** Speaker 4EZ1A4 (used with trunk-mount only)	1	1	1
1	1	1	1	**12.** Microphone a) 4EM10A2 (for mobile) or b) 4EM9B1 (for station)		1	1
1	1	1	1	**13.** Suppressor Kit (low band only)			
1	1	1	1	**14.** Mounting Brackets PL-7147296-G1 (provided with Front-Mount only; otherwise optional)	1	1	1
1	1	1	1	**15.** Right-Angle Antenna Connector M-2R22-P2 (provided with Front-Mount only)	1	1	1
1	1	1	1	**16.** Mounting Hardware PL-7142621-G2 or 3 (not provided with a-c mobile combinations)	1	1	1
1	1	1	1	**17.** Antenna Tool PL-7139389-G1			
1	1	1	1	**18.** Mounting Foot Kit PL-4029287-G1 (AC Mobiles only)	1	1	1
1	1	1	1	**19.** Ventilated Cover PL-7774390-G9 (AC Mobiles only)	1	1	1

COMMUNICATION PRODUCTS DEPARTMENT

GENERAL ELECTRIC

MOUNTAIN VIEW ROAD • LYNCHBURG, VIRGINIA

INSTALLATION INSTRUCTIONS FOR PROGRESS LINE AC MOBILE COMBINATIONS

General Electric AC Mobile Combinations provide compact, economical base stations for two-way radio communication. The combinations feature the same reliable transmitters and receivers employed in DC Mobile and Fixed Station Combinations. The transmitter, receiver and power supply are mounted in a mobile rack, which is housed in the sturdy, attractive mobile case. AC Mobile Combinations are furnished with either a front-mount control unit or with an extended-local control unit. Both types of control unit include a built-in speaker, a VOLUME control, a SQUELCH control, a power switch, a power-on indicator, a transmit indicator, a microphone receptacle, and a power input plug. Front-mount control units mount on the front end plate of the transmitter-receiver case. Extended-local control units may be mounted at some distance from the transmitter-receiver. This permits mounting the control unit on a desk near the dispatcher and mounting the mobile case at a more convenient location.

The AC Mobile Combinations are designed to meet RETMA Specifications for intermittent-duty operation, i.e., continuous duty on standby and a transmit duty cycle of 1 minute on and 4 minutes off. Rapid interchangeability of the transmitter and receiver chassis between mobile and station combinations greatly reduces the number of spare units required and the amount of out-of-service time.

The Mobile Transmitter-Receiver may be mounted in any position close to the antenna transmission line and a source of line voltage. The control unit should be mounted on a desk or shelf within convenient reach of the dispatcher. In combinations employing a extended-local control unit, the transmitter-receiver may normally be mounted up to 23 feet (the length of the control cable) from the control unit.

MOBILE TRANSMITTER-RECEIVER

Remove the transmitter-receiver chassis and the cover from the mobile case and, if the case is not going to be fastened permanently to the mounting surface, install the four rubber feet (supplied with the combination) on the case. The cover of the case may be made stationary, thereby providing a drawer-type case by drilling two .098-inch holes at location "D" (see Installation Diagram for the mobile case) with a #40 (3/32-inch) drill, and secure it with #4 sheet metal screws.

MICROPHONE

The desk-type microphone normally supplied with AC Mobile Combinations should be placed within convenient reach of the dispatcher and connected to the microphone jack on the control unit.

ANTENNA

Instructions for installing the antenna and its transmission line are provided on Installation Diagram D-7667600 (see Table of Contents). Installation Diagram A-7135401, 2 in this instruction book will aid in the assembly of UHF connectors on the ends of the transmission line. Keep the transmission line as short as possible. Proper placement of the antenna is essential for proper operation of the system. Connect the transmission line to the antenna jack on the front of the mobile case.

CONTROL CABLE
(Extended-Local Control Only)

1. Carefully pry the back cover from the base of the Extended-Local Control Unit.

2. Remove the four screws inside the back of the case which hold the control unit to the base.

3. Mount the 21-pin male connector, which is on the end of the control cable, at the left side of the rectangular opening inside the back of the base, using the two screws present. Install the connector so that the contacts face forward.

4. Connect the 21-pin female connector which is inside the control unit to the connector installed in the preceding step and screw control unit back onto the base.

5. Clamp the control cable under the empty cable clamp inside the rear of the base.

6. Replace the back cover on the base by pressing the push rivets into the proper holes in the base.

POWER CABLE

Plug the 4-pin plug on the short cable from the control unit into the 6-foot power cable and connect the power cable to 117-volt, 60-cycle a-c outlet. The mobile case should be grounded to a good earth ground to protect service and operating personnel. After grounding the chassis, check the resistance to ground with an ohmmeter to be sure that it is well grounded.

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.

ADJUSTMENT, OPERATION AND MAINTENANCE
144-174 MC
PROGRESS LINE MOBILE COMBINATIONS

After the system has been installed, there are a few checks and system adjustments required before placing the transmitter-receiver in service. DO NOT TRY TO TOUCH-UP TUNING CONTROLS AFFECTING THE ALIGNMENT OF THE UNITS, as each unit has been factory aligned to the specified frequency before shipment. Operation will only be degraded if touch-up is attempted. Complete ALIGNMENT PROCEDURES are included in the Instruction Book if modifications are made or evidence of misalignment is present.

ADJUSTMENT

TOOLS REQUIRED

1. A tuning tool and screw driver.
2. A 20,000 ohm-per-volt meter which covers the 0-3 volt range (G-E Test Set Type EX-1-C, G-E Shock Resistant Test Meter Type EX-2-B or equivalent meter).
3. Access to a transmitter signal on the system frequency for receiver adjustment.

TRANSMITTER PROCEDURE

CAUTION

> Do not key transmitter for periods exceeding 30 seconds in each minute until MULT. 4 PLATE has been tuned.

The antenna or suitable load should be connected to the Antenna Input Jack J111 for the following procedures. The channel A or single frequency crystal should be inserted between pins 4 and 6 of crystal socket XY101. The Channel B crystal, for two frequency operation, should be inserted between pins 2 and 8 of crystal socket XY101.

1. Place the TUNE-OPERATE switch in the TUNE position.

2. Rotate the ANT COUPLING control to extreme clockwise position (uncoupled).

3. Turn power on and allow 30 seconds for warm-up.

4. Plug the positive meter probe into the CATH PA jack and the negative meter probe in the GND jack on the Power Supply chassis.

5. Key the transmitter and tune the PA PLATE tuning control for a minimum (dip).

6. Place TUNE-OPERATE switch in OPERATE position.

7. Key the transmitter and tune the MULT-4 PLATE and PA GRID (ET-20-A) tuning controls for a minimum meter reading at the CATH PA jack.

8. Key transmitter and tune the PA PLATE and ANT TUNING controls alternately until lower meter reading cannot be obtained.

9. Key transmitter and peak the ANT TUNING control. If indication is not obtainable, increase setting of ANT COUPLING control slightly (10° or so) counterclockwise until obtainable. Do not overcouple or false setting will be obtained.

10. Key the transmitter and adjust the ANT COUPLING control for a reading of 1.4 volts (on 25 or 50-watt transmitters)

11. Key transmitter and adjust ANT TUNING control for maximum meter indication.

12. Key the transmitter and adjust the ANT COUPLING control for a meter reading to 1.6 volts on 25-watt transmitters, 1.5 volts on 50-watt transmitters, or 1.1 volts on 10-watt transmitters. *

13. Remove both meter probes and plug the negative probe into the PA GRID jack and the positive probe in the GND jack.

14. Key the transmitter and tune the MULT-4 PLATE and PA GRID for maximum meter indication.

---

* For FCC purposes, the plate current of the power amplifier stage may be accurately calculated in milliamperes by multiplying the reading at the CATH PA jack by the conversion factor as listed:

Type ET-20-A - 1 volt = 100 milliamperes
Type ET-21-A - 1 volt = 200 milliamperes

15. Remove both meter probes and plug the positive probe into the CATH PA jack and the negative probe in the GND jack.

16. Repeat step 11.

17. Repeat step 12.

RECEIVER PROCEDURE

The antenna should be connected for the procedures below:

1. Plug the negative probe of the tuning meter in the LIM-1 jack and the positive probe in the GND jack on the power supply chassis.

2. This step applied to receivers which have not been pre-tuned prior to installation. While receiving a weak (LIM-1 reads below limiting) unmodulated signal on the system frequency (exact frequency of transmitter to be monitored), peak the Antenna Transformer (T301 or T322) preselector circuit trimmers, C3 (on bottom of transformer) and then C1 (on top of transformer). Once peaked, C1 and C3 should be tuned for maximum quieting. Depending upon the receiver operating frequency, maximum LIM-1 current and maximum quieting may not occur together. Where this is the case, always tune for maximum quieting.

3. Remove negative probe from LIM-1 jack and insert in DISC jack.

4. While receiving a strong, unmodulated signal on the system frequency (exact frequency of transmitter to be monitored), note the meter reading. If the discriminator meter reads more than ± 0.2 volts (20,000 ohm-per-volt meter) or 1.0 volt (VTVM) and the transmitter is known to be on frequency, adjust the OSC-1 trimmer (FA) for zero discriminator reading.

5. Under no carrier condition, rotate the SQUELCH control on the Control Unit fully clockwise, or until noise is heard in the loudspeaker, then rotate counterclockwise until the noise just disappears. (For general use, turn the control approximately 15° past the point where the noise just disappears).

6. While monitoring a modulated signal, adjust the VOLUME control on the Control Unit for the desired listening level.

Provisions have been made for measuring audio between pins 1 and 4 of the microphone receptacle on the Power Supply chassis.

OPERATION

Power may be applied to the unit by turning the control unit Volume Control ON. The green pilot on the control unit will be illuminated when the voltage is supplied to the units. This light remains glowing all the time the equipment is ON and indicates standby condition. The red pilot light on the Control Unit will be turned on when the transmitter is on-the-air. When the microphone or handset push-to-talk button is depressed, plate voltage is applied to the transmitter, the red pilot light glows, the transmitter carrier is radiated and the loudspeaker is muted. Upon release of the PTT button, the receiver becomes operative and the red pilot light goes off. The two adjustable controls marked VOLUME and SQUELCH should be adjusted upon installation. The VOLUME control raises or lowers the sound level as heard from the loudspeaker or handset ear piece. The SQUELCH control setting is a critical adjustment for efficient operation. Essentially, its function is to mute the loudspeaker while no signals are being received.

MICROPHONE TECHNIQUE

Misuse of the microphone is probably the greatest single reason for so called "poor transmitter performance". Some attention should, therefore, be given to the proper use of the microphone. When talking, the microphone or handset transmitter should be held so that operator talks directly across it and the voice should be kept to the normal speaking level. If the operator speaks distinctly, in a normal voice, the message can be easily understood. It is to the operator's advantage to try a few calls and through practice and constructive criticism at the receiving end, develop a microphone technique that is best suited to his characteristics of speech.

MAINTENANCE

1. To insure good electrical continuity and high operating efficiency, routine checks should be made of all mechanical and electrical connections and parts. Connections to the voltage source should be periodically checked for tightness. Loose or poor connections to the power source will cause excessive voltage drops and faulty operation may ensue. If used in a vehicle, the generator and generator regulator should be maintained regularly to keep the generating system within safe and economical operating limits. The vehicle regulator is the basis of control and should automatically limit the charging circuit from

exceeding pre-determined values. If generator voltage is excessive, tubes, lights, etc. may burn out prematurely. This condition is indicated when the battery loses water rapidly. Usage of 1 or 2 ounces of water per cell per week is acceptable for batteries in continuous operation.

2. Any deposit of corrosion, grease or extraneous matter should be removed by an appropriate solvent.

3. Since mobile units are often subject to constant shock and vibration, it is advisable to check for loose plugs, nuts, screws and parts to make sure that nothing is working loose.

4. Examine the contacts of the relays. Where relay contacts carry little or no current, the contacts do not clean themselves and an insulating coating is apt to form. Current-carrying contacts are subject to pitting and should be burnished from time to time. When contacts become coated, remove the film with a suitable solvent applied with a non-metallic brush, such as a tooth brush. Dust and particles should be removed by a clean, dry, non-metallic brush.

5. The antenna, antenna base and all contacts should be kept clean and free from dirt or corrosion. If the antenna or its base is covered with an insulating coat or is poorly grounded, loss of radiation and a weak signal will result.

6. If Dynamotor Power Supply Model 4EP2C1, 4EP2D1 or 4EP2K1 is used, the dynamotor will require reasonable maintenance. The input brushes of the dynamotor should normally average approximately 300 hours, and the output brushes should realize 3 or 4 times longer life than the input brushes, depending upon temperature, humidity and atmospheric conditions. The diamond-finished commutator greatly extends brush and commutator life by providing a perfectly concentric, smooth surface. To prevent damage to the commutator, replace each brush when the Line-O-Life mark on the brush is reached. Eccentricity of the commutator must be less than .001, and preferably no more than .005 for long brush and commutator life. Information for ordering parts is contained on the Parts List located on the back of the Elementary Diagram. Do not file the brushes to fit the brush holders. Never file the inside of the brush holder. WHERE SERVICE OTHER THAN BRUSH REPLACEMENT IS REQUIRED, IT IS RECOMMENDED THAT THE DYNAMOTOR BE RETURNED TO THE SERVICE DEPARTMENT OF THE DYNAMOTOR MANUFACTURER.

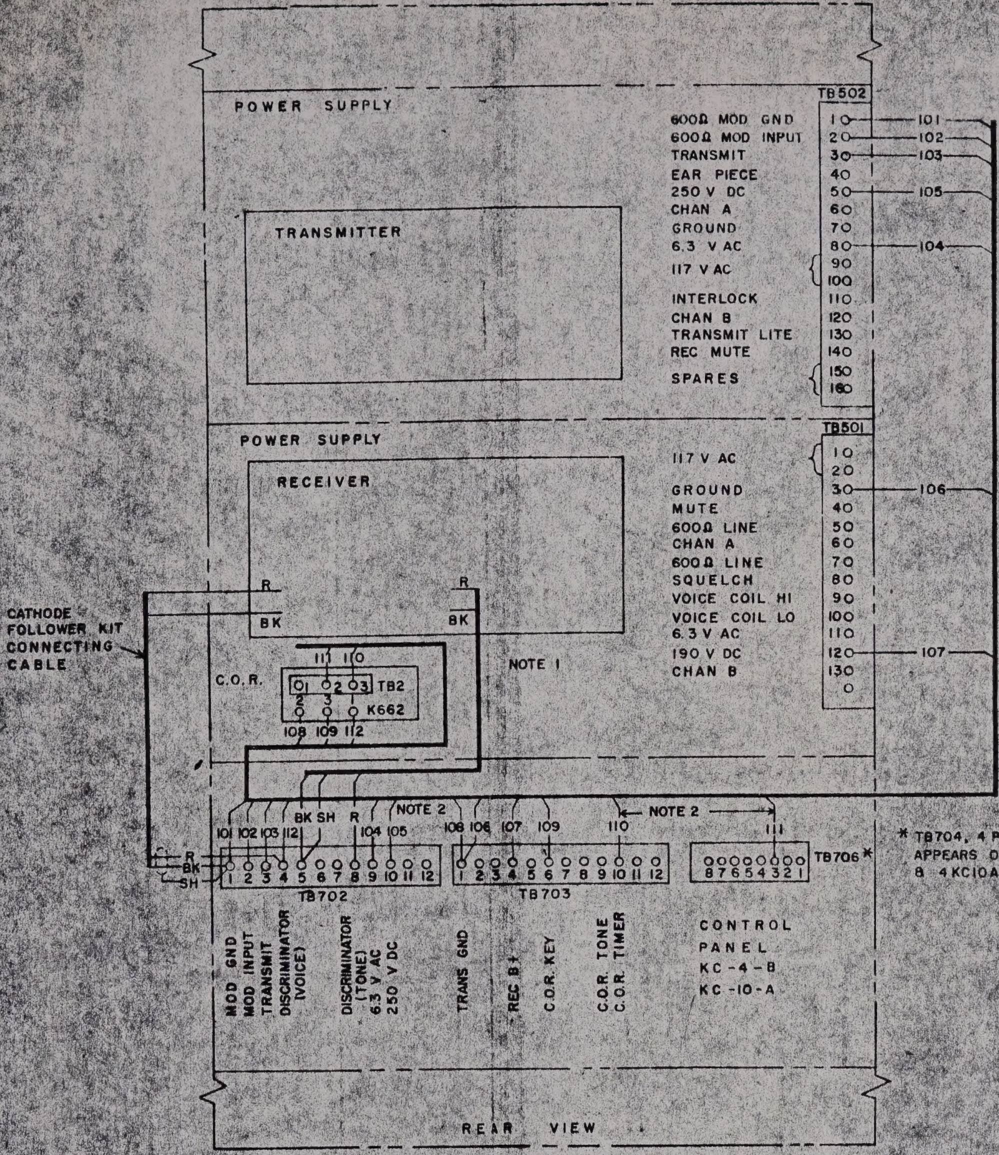
After 200 to 5000 hours, or approximately 1 year of service, it may be necessary to have the commutators machined or trued-up. Commutators are undercut to withstand several machinings before re-undercutting of the segments is necessary. If the dynamotor cannot be returned to the factory for this, take off a minimum amount of copper, remove all chips between segments with tooth brush to prevent shorted windings, and be sure no burrs are made on segment or bare edges when machining, or excessive brush sparking and wear result. When removing the armature for servicing, first remove all four brushes.

The dynamotor bearings have been lubricated for the average life of the dynamotor. Lubrication of the bearings should not be attempted unless it is a definite necessity, and then only by someone experienced in this procedure. If it is required, Andok "C" grease will operate satisfactorily from -55^{o}F to 200^{o}F. Above these temperatures, the grease may carbonize and fail to lubricate the bearing properly.

Refer to the unit description and Maintenance instructions for regular maintenance information suggested for care of the individual units.

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.


POWER SUPPLY
TRANSMITTER
TB502
600Ω MOD GND
600Ω MOD INPUT
TRANSMIT
EAR PIECE
250 V DC
CHAN A
GROUND
6.3 V AC
117 V AC
INTERLOCK
CHAN B
TRANSMIT LITE
REC MUTE
SPARES
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
101
102
103
105
104
POWER SUPPLY
RECEIVER
TB501
117 V AC
GROUND
MUTE
600Ω LINE
CHAN A
600Ω LINE
SQUELCH
VOICE COIL HI
VOICE COIL LO
6.3 V AC
190 V DC
CHAN B
1 2 3 4 5 6 7 8 9 10 11 12 13
106
107
R
BK
R
BK
CATHODE FOLLOWER KIT CONNECTING CABLE
C.O.R.
111 110
1 2 3
TB2
2 3
K662
108 109 112
NOTE 1
BK SH R
NOTE 2
NOTE 2
101 102 103 112
104 105
108 106 107 109
110
111
R
BK
SH
1 2 3 4 5 6 7 8 9 10 11 12
TB702
1 2 3 4 5 6 7 8 9 10 11 12
TB703
8 7 6 5 4 3 2 1
TB706*
MOD GND
MOD INPUT
TRANSMIT
DISCRIMINATOR (VOICE)
DISCRIMINATOR (TONE)
6.3 V AC
250 V DC
TRANS GND
REC B+
C.O.R. KEY
C.O.R. TONE
C.O.R. TIMER
CONTROL PANEL
KC-4-B
KC-10-A
REAR VIEW

* TB704, 4 POINT BOARD APPEARS ON 4KC4B1 & 4KC10A2.

NOTE 1: THIS CABLE IS USED ONLY WITH TONE COMPENSATING NETWORK 7143592 G1 AND CONTROL PANEL KC-10-A.

NOTE 2: THE CONNECTIONS AS SHOWN ARE FOR CONTROL PANEL KC-4-B. FOR CONTROL PANELS 4KC10A1 & 2, PROCEED AS FOLLOWS:

a REMOVE WIRES 104 & 105
b CONNECT WIRE 110 TO TB703-9 INSTEAD OF TB703-10
c CONNECT WIRE 111 TO TB703-1 INSTEAD OF TB704-3

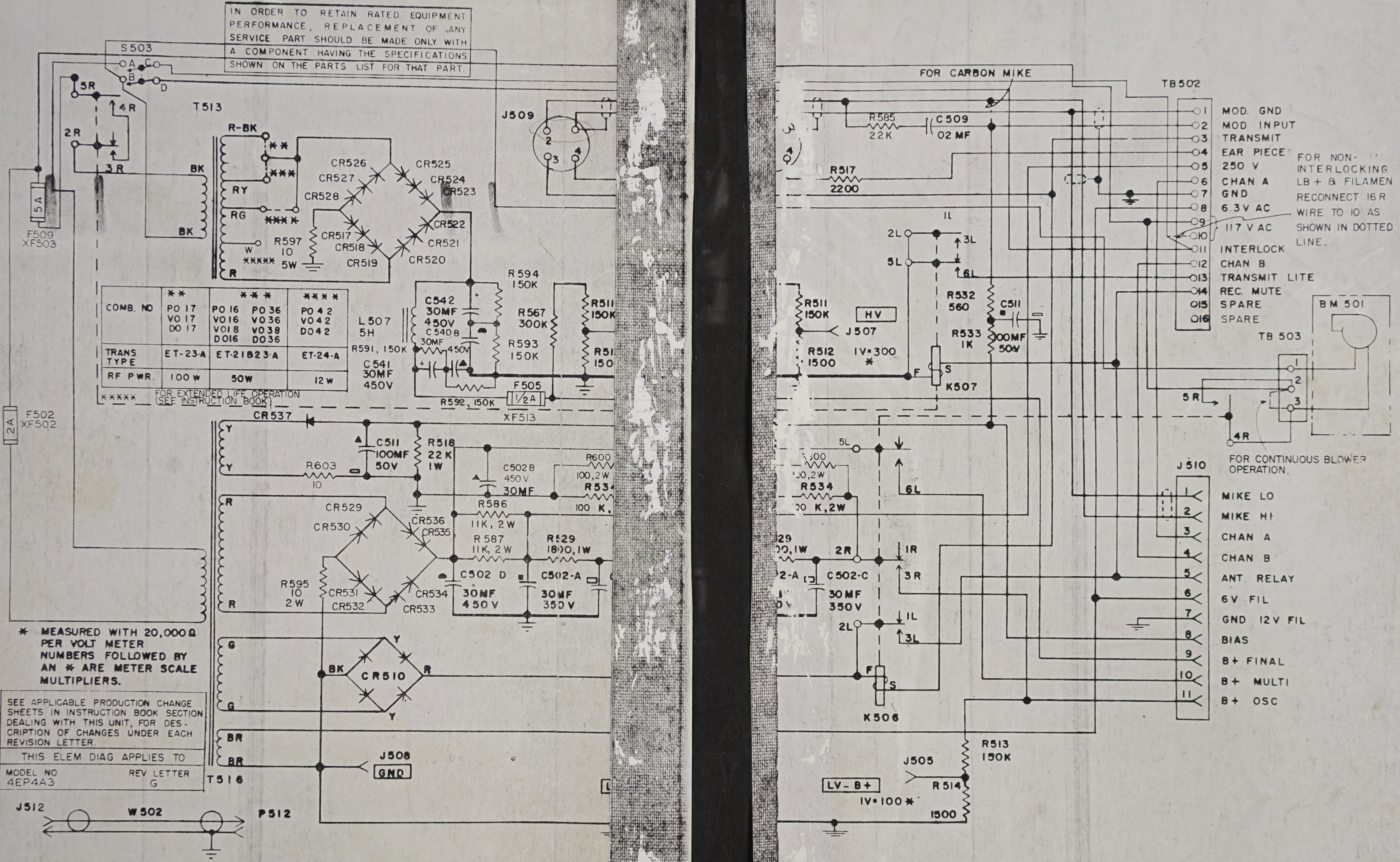
FOR CONTROL PANEL 4KC10A3, PROCEED AS FOLLOWS:

a REMOVE WIRES 104, 105, 110 & 111.

Interconnection Diagram

RELAY CONTROL OVERLAY HARNESS

(C-7775870, Rev. 7)


S503
A
B
C
D
5R
4R
2R
3R
T513
R-BK
BK
RY
RG
W
R
F509
XF503
5A
F502
XF502
2A
CR526
CR527
CR528
CR525
CR524
CR523
CR522
CR521
CR520
CR519
CR518
CR517
R597
10
5W
J509
C542
30MF
450V
C540B
30MF
450V
L507
5H
R591, 150K
C541
30MF
450V
R594
150K
R567
300K
R593
150K
R511
150K
R512
1500
F505
1/2A
XF513
R592, 150K
CR537
C511
100MF
50V
R518
22K
1W
R603
10
C502B
450V
30MF
R600
100,2W
R534
100 K, 2W
R586
11K, 2W
R587
11K, 2W
R529
1800, 1W
C502 D
30MF
450V
C502-A
30MF
350V
C502-C
30MF
350V
CR529
CR530
CR536
CR535
CR531
CR532
CR534
CR533
R595
10
2W
CR510
BK
R
Y
G
BR
T516
J508
GND
J512
W502
P512
FOR CARBON MIKE
R585
22K
C509
.02 MF
R517
2200
HV
J507
IV=300 *
1L
2L
3L
5L
6L
1R
2R
3R
R532
560
R533
1K
C511
100MF
50V
F
S
K507
K506
R513
150K
J505
LV-B+
R514
1500
IV=100 *
TB502
1 MOD. GND
2 MOD INPUT
3 TRANSMIT
4 EAR PIECE
5 250 V
6 CHAN A
7 GND
8 6.3V AC
9 117 V AC
10
11 INTERLOCK
12 CHAN B
13 TRANSMIT LITE
14 REC. MUTE
15 SPARE
16 SPARE
FOR NON-INTERLOCKING LB+ & FILAMEN RECONNECT 16R WIRE TO 10 AS SHOWN IN DOTTED LINE.
BM 501
TB 503
1
2
3
5R
4R
FOR CONTINUOUS BLOWER OPERATION.
J510
1 MIKE LO
2 MIKE HI
3 CHAN A
4 CHAN B
5 ANT. RELAY
6 6V FIL
7 GND 12V FIL
8 BIAS
9 B+ FINAL
10 B+ MULTI
11 B+ OSC

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

	**	***		****
COMB. NO	PO 17 VO 17 DO 17	PO 16 VO 16 VO 18 DO 16	PO 36 VO 36 VO 38 DO 36	PO 4 2 VO 4 2 DO 4 2
TRANS. TYPE	ET-23-A	ET-21823-A		ET-24-A
RF PWR.	100 W	50W		12 W

***** FOR EXTENDED LIFE OPERATION (SEE INSTRUCTION BOOK)

* MEASURED WITH 20,000Ω PER VOLT METER NUMBERS FOLLOWED BY AN * ARE METER SCALE MULTIPLIERS.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

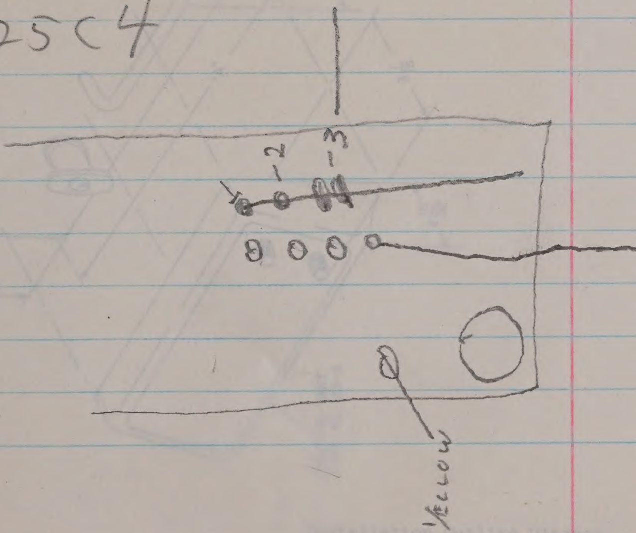
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EP4A3	G

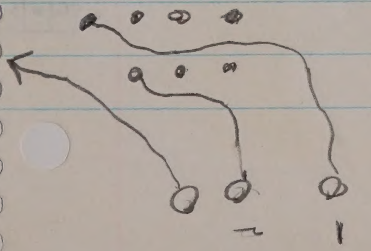
Elementary Diagram

TRANSMITTER POWER SUPPLY
MODEL 4EP4A3, REV. G

(C-5494811, Rev. 12)

4EK25C4





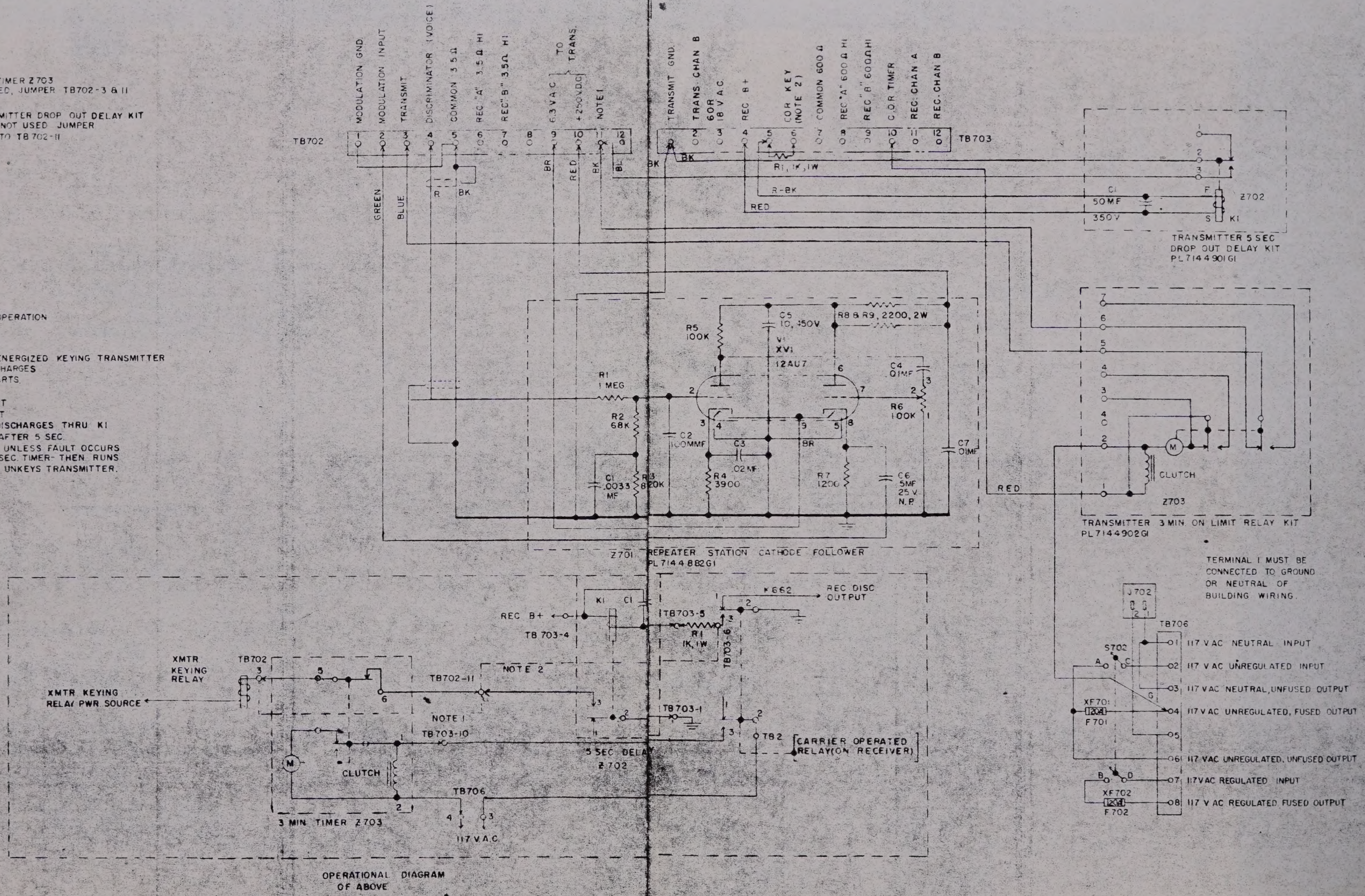
NOTE 1 IF 3 MIN TIMER Z703
IS NOT USED, JUMPER TB702-3 & 11

NOTE 2 IF TRANSMITTER DROP OUT DELAY KIT
Z702 IS NOT USED JUMPER
TB703-6 TO TB702-11

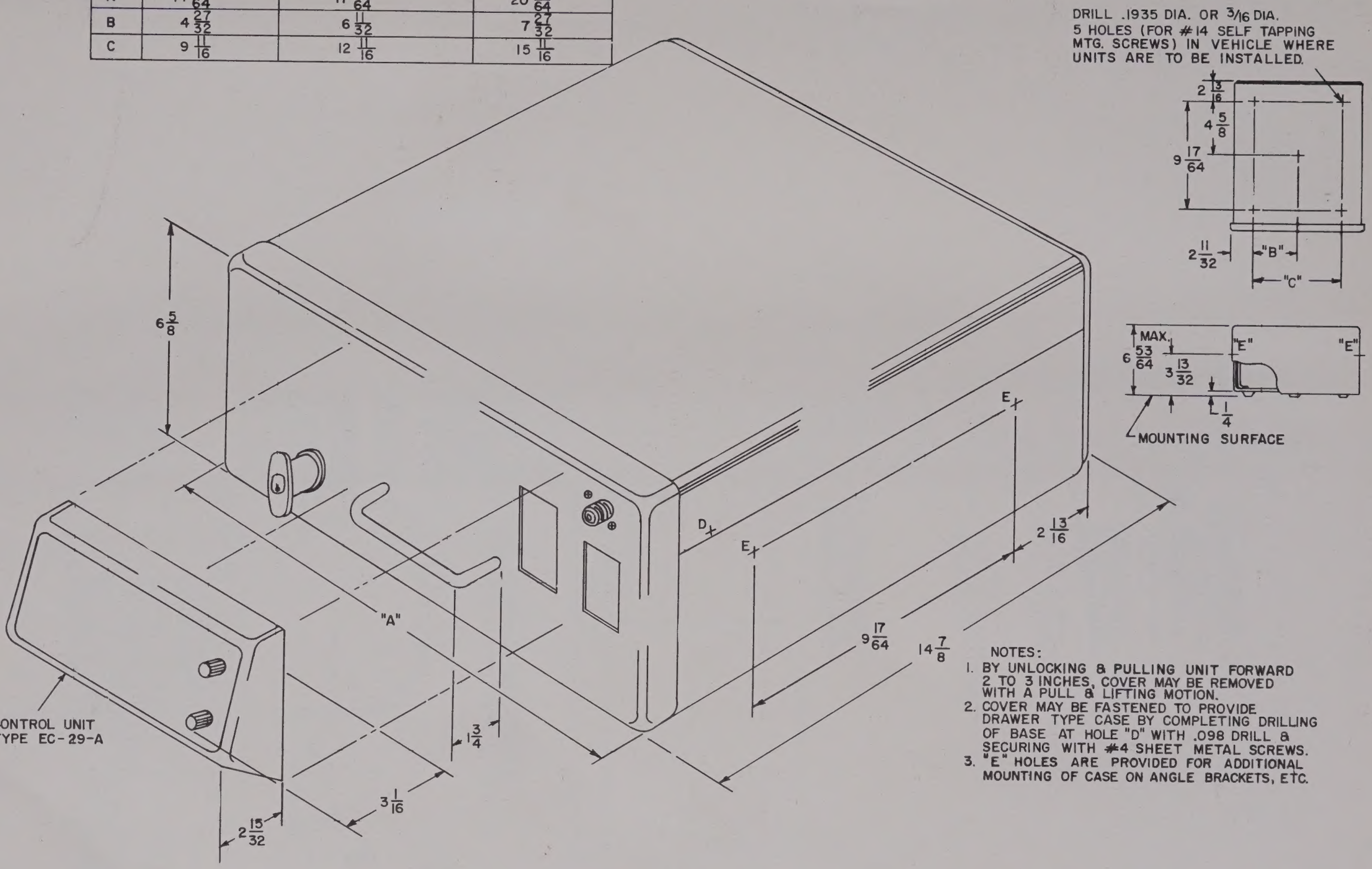
SEQUENCE OF OPERATION

1. CARRIER COMES IN
   - a) C.O.R. PICKS UP
   - b) RELAY K1 IS ENERGIZED KEYING TRANSMITTER
   - c) CAPACITOR C1 CHARGES
   - d) 3 MIN. TIMER STARTS.

2. CARRIER DROPS OUT
   - a) C.O.R. DROPS OUT
   - b) CAPACITOR C1 DISCHARGES THRU K1
   - c) K1 DROPS OUT AFTER 5 SEC.
   - d) TIMER RESETS UNLESS FAULT OCCURS IN C.O.R. OR 5 SEC. TIMER- THEN RUNS FOR 3 MIN. AND UNKEYS TRANSMITTER.


TB702
1 MODULATION GND.
2 MODULATION INPUT
3 TRANSMIT
4 DISCRIMINATOR (VOICE)
5 COMMON 3.5 Ω
6 REC "A" 3.5 Ω HI
7 REC "B" 3.5Ω HI
8
9 6.3 V.A.C.
10 +250V.D.C.
TO TRANS.
11 NOTE 1
12
GREEN
BLUE
R
BK
BR
RED
BK
BL
TB703
1 TRANSMIT GND.
2 TRANS. CHAN B
60R
3 18 V.A.C.
4 REC B+
5
6 COR KEY (NOTE 2)
7 COMMON 600 Ω
8 REC "A" 600 Ω HI
9 REC "B" 600Ω HI
10 C.O.R TIMER
11 REC. CHAN A
12 REC. CHAN B
BK
R1, 1K, 1W
R-BK
RED
C1
50MF
350V
F
S
K1
Z702
TRANSMITTER 5 SEC
DROP OUT DELAY KIT
PL7144901G1
R5
100K
C5
10, 450V
R8 & R9, 2200, 2W
V1
XV1
12AU7
C4
.01MF
R1
1 MEG
R2
68K
C2
100MMF
C3
.02MF
R6
100K
C7
.01MF
C1
.0033
MF
R3
820K
R4
3900
BR
R7
1200
C6
5MF
25 V.
N.P.
Z701
REPEATER STATION CATHODE FOLLOWER
PL7144882G1
1 2 3 4 C 4 5 6 7
M
CLUTCH
RED
Z703
TRANSMITTER 3 MIN. ON LIMIT RELAY KIT
PL7144902G1
TERMINAL 1 MUST BE
CONNECTED TO GROUND
OR NEUTRAL OF
BUILDING WIRING.
J702
TB706
S702
A
C
G
XF701
F701
B
D
XF702
F702
1 117 V.AC NEUTRAL INPUT
2 117 V.AC UNREGULATED INPUT
3 117 V.AC NEUTRAL, UNFUSED OUTPUT
4 117 V.AC UNREGULATED, FUSED OUTPUT
5
6 117 V.AC UNREGULATED, UNFUSED OUTPUT
7 117V.AC REGULATED INPUT
8 117 V.AC REGULATED FUSED OUTPUT
K1
C1
REC B+
TB 703-4
TB703-5
R1
1K, 1W
TB703-6
K662
REC DISC
OUTPUT
XMTR
KEYING
RELAY
XMTR KEYING
RELAY PWR SOURCE
TB702
3
5
6
TB702-11
NOTE 2
NOTE 1
TB703-1
TB703-10
TB2
CARRIER OPERATED
RELAY(ON RECEIVER)
M
CLUTCH
5 SEC DELAY
Z702
TB706
3 MIN. TIMER Z703
117 V.A.C.
OPERATIONAL DIAGRAM
OF ABOVE

DIM.	STANDARD CASE	CASE WITH OPTION PANEL	CASE WITH W.E. PANEL
A	$14\frac{31}{64}$	$17\frac{31}{64}$	$20\frac{31}{64}$
B	$4\frac{27}{32}$	$6\frac{11}{32}$	$7\frac{27}{32}$
C	$9\frac{11}{16}$	$12\frac{11}{16}$	$15\frac{11}{16}$



DRILL .1935 DIA. OR 3/16 DIA. 5 HOLES (FOR #14 SELF TAPPING MTG. SCREWS) IN VEHICLE WHERE UNITS ARE TO BE INSTALLED.

$2\frac{13}{16}$
$4\frac{5}{8}$
$9\frac{17}{64}$
$2\frac{11}{32}$
"B"
"C"
MAX.
$6\frac{53}{64}$
$3\frac{13}{32}$
$\frac{1}{4}$
"E"
"E"
MOUNTING SURFACE
$6\frac{5}{8}$
E
D
E
$2\frac{13}{16}$
$9\frac{17}{64}$
$14\frac{7}{8}$
"A"
$1\frac{3}{4}$
$3\frac{1}{16}$
$2\frac{15}{32}$
CONTROL UNIT
TYPE EC-29-A

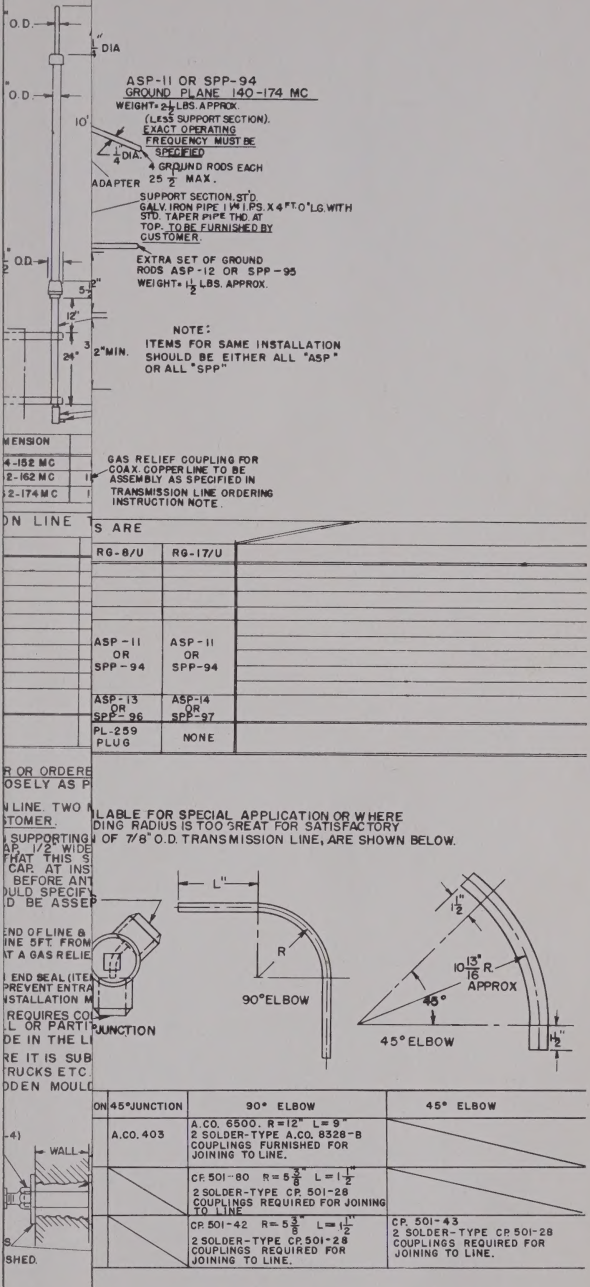
NOTES:

1. BY UNLOCKING & PULLING UNIT FORWARD 2 TO 3 INCHES, COVER MAY BE REMOVED WITH A PULL & LIFTING MOTION.
2. COVER MAY BE FASTENED TO PROVIDE DRAWER TYPE CASE BY COMPLETING DRILLING OF BASE AT HOLE "D" WITH .098 DRILL & SECURING WITH #4 SHEET METAL SCREWS.
3. "E" HOLES ARE PROVIDED FOR ADDITIONAL MOUNTING OF CASE ON ANGLE BRACKETS, ETC.

Installation Outline Diagram

MOBILE TRANSMITTER-RECEIVER
CASE

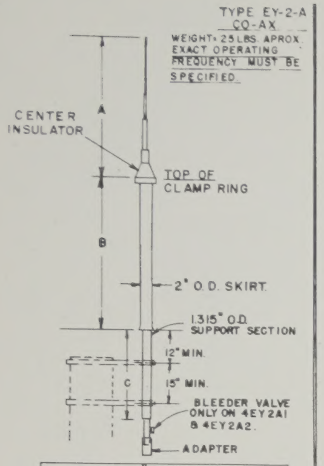
(C-7775814, Rev. 4)


O.D.
1/4" DIA
O.D.
10'
ASP-11 OR SPP-94
GROUND PLANE 140-174 MC
WEIGHT= 2 1/2 LBS. APPROX.
(LESS SUPPORT SECTION).
EXACT OPERATING FREQUENCY MUST BE SPECIFIED
1/4" DIA.
4 GROUND RODS EACH 25 1/2 MAX.
ADAPTER
SUPPORT SECTION, ST'D.
GALV. IRON PIPE 1 1/4 I.P.S. X 4 FT. 0" LG. WITH STD. TAPER PIPE THD. AT TOP. TO BE FURNISHED BY CUSTOMER.
1/2 O.D.
EXTRA SET OF GROUND RODS ASP-12 OR SPP-95
WEIGHT= 1 1/2 LBS. APPROX.
5 1/2"
12'
24"
3 2" MIN.
NOTE:
ITEMS FOR SAME INSTALLATION SHOULD BE EITHER ALL "ASP" OR ALL "SPP"
MENSION
4-152 MC
2-162 MC
2-174 MC
GAS RELIEF COUPLING FOR COAX. COPPER LINE TO BE ASSEMBLY AS SPECIFIED IN TRANSMISSION LINE ORDERING INSTRUCTION NOTE.
N LINE
S ARE
RG-8/U
RG-17/U
ASP-11 OR SPP-94
ASP-11 OR SPP-94
ASP-13 OR SPP-96
ASP-14 OR SPP-97
PL-259 PLUG
NONE
R OR ORDERE
OSELY AS P
LINE. TWO
STOMER.
SUPPORTING
AP. 1/2 WIDE
THAT THIS S
CAP. AT INS
BEFORE ANT
ULD SPECIFY
D BE ASSE
END OF LINE &
INE 5FT. FROM
T A GAS RELIE
END SEAL (ITE
PREVENT ENTRA
NSTALLATION M
REQUIRES CO
L OR PARTI
DE IN THE LI
RE IT IS SUB
RUCKS ETC.
DEN MOUL
LABLE FOR SPECIAL APPLICATION OR WHERE
DING RADIUS IS TOO GREAT FOR SATISFACTORY
OF 7/8" O.D. TRANSMISSION LINE, ARE SHOWN BELOW.
JUNCTION
L"
R
90° ELBOW
1 1/2"
10 13/16" R. APPROX
45°
45° ELBOW
1/2"
ON
45° JUNCTION
90° ELBOW
45° ELBOW
A.CO. 403
A.CO. 6500. R=12" L=9" 2 SOLDER-TYPE A.CO. 8328-B COUPLINGS FURNISHED FOR JOINING TO LINE.
CP. 501-80 R=5 3/8" L=1 1/2" 2 SOLDER-TYPE CP. 501-28 COUPLINGS REQUIRED FOR JOINING TO LINE
CP. 501-42 R=5 3/8" L=1 1/2" 2 SOLDER-TYPE CP. 501-28 COUPLINGS REQUIRED FOR JOINING TO LINE.
CP. 501-43 2 SOLDER-TYPE CP. 501-28 COUPLINGS REQUIRED FOR JOINING TO LINE.
-4)
WALL
S
SHED.

Installation Diagram

25-50 MC, 72-76 MC, AND
144-174 MC STATION ANTENNAS

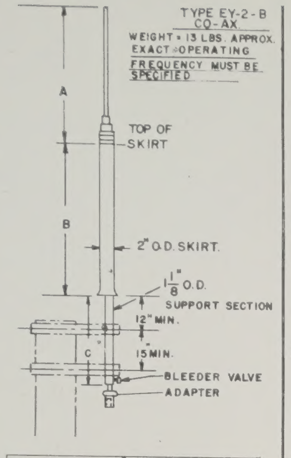
(D-7667600, Sheet 1, Rev. 9)


A
B
C
CENTER INSULATOR
TOP OF CLAMP RING
2" O.D. SKIRT
1.315" O.D. SUPPORT SECTION
12" MIN.
15" MIN.
BLEEDER VALVE ONLY ON 4EY2A1 & 4EY2A2.
ADAPTER

TYPE EY-2-A CO-AX

WEIGHT = 25 LBS. APROX. EXACT OPERATING FREQUENCY MUST BE SPECIFIED.

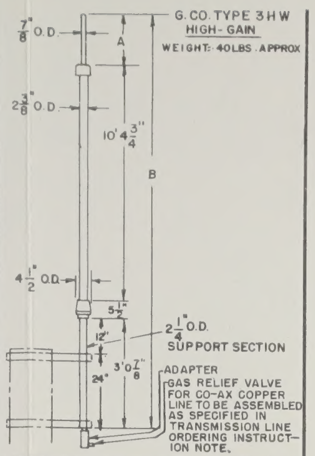
DIMENSION	25-50 MC	
	MAX.	MIN.
A	118	57 1/2
B	110 1/2"	55
C	72	31 1/2


A
B
C
TOP OF SKIRT
2" O.D. SKIRT.
$1\frac{1}{8}$" O.D. SUPPORT SECTION
12" MIN.
15 MIN.
BLEEDER VALVE
ADAPTER

TYPE EY-2-B CO-AX.

WEIGHT = 13 LBS. APPROX. EXACT OPERATING FREQUENCY MUST BE SPECIFIED

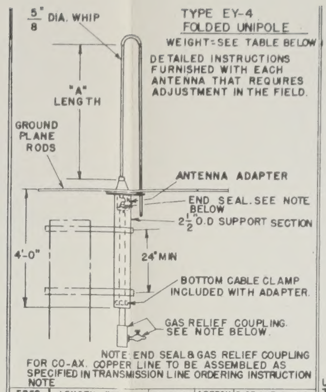
DIMENSION	148-174 MC	
	MAX.	MIN.
A	20.0"	18.75"
B	18.95"	17.3"
C	33.7"	32.05"


$\frac{7}{8}$" O.D.
A
$2\frac{3}{8}$" O.D.
10' $4\frac{3}{4}$"
B
$4\frac{1}{2}$" O.D.
$5\frac{1}{2}$"
12"
24"
3' 0 $\frac{7}{8}$"
$2\frac{1}{4}$" O.D. SUPPORT SECTION
ADAPTER
GAS RELIEF VALVE FOR CO-AX COPPER LINE TO BE ASSEMBLED AS SPECIFIED IN TRANSMISSION LINE ORDERING INSTRUCTION NOTE.

G.CO. TYPE 3HW HIGH-GAIN

WEIGHT: 40 LBS. APPROX

DIMENSION	A	B
144-152 MC	18"	15 FT. 5 1/8"
152-162 MC	11 1/2"	14 FT. 10 5/8"
162-174 MC	12"	14 FT. 11 1/8"


$\frac{5}{8}$" DIA. WHIP
"A" LENGTH
GROUND PLANE RODS
ANTENNA ADAPTER
END SEAL. SEE NOTE BELOW
$2\frac{1}{2}$" O.D SUPPORT SECTION
4'-0"
24" MIN
BOTTOM CABLE CLAMP INCLUDED WITH ADAPTER.
GAS RELIEF COUPLING. SEE NOTE BELOW.

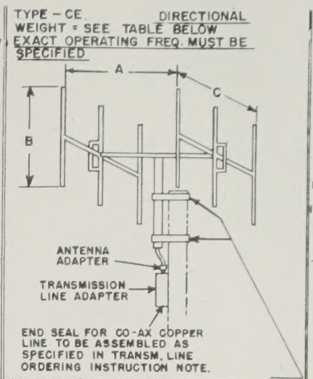
TYPE EY-4 FOLDED UNIPOLE

WEIGHT = SEE TABLE BELOW

DETAILED INSTRUCTIONS FURNISHED WITH EACH ANTENNA THAT REQUIRES ADJUSTMENT IN THE FIELD.

NOTE: END SEAL & GAS RELIEF COUPLING FOR CO-AX. COPPER LINE TO BE ASSEMBLED AS SPECIFIED IN TRANSMISSION LINE ORDERING INSTRUCTION NOTE

FREQ. RANGE (MC)	LENGTH "A"	ADJUSTED IN FIELD?	APPROX WEIGHT IN LBS.	℄ OF ANT. TO END OF GROUND RODS
25-30	9 FT-7" TO 7 FT. 5 1/2"	YES	35	114"
30-44	7' 9" TO 4' 5"	YES	27	95"
44-50	4' 9 3/4" TO 3' 11 1/4"	YES	27	79"
72-76	2' 7 5/8" TO 2' 3 1/4"	YES	25	47"
148-152	15 7/8"	NO	17	30"
152-157	15 1/2"	NO	17	29"
157-162	14 1/2"	NO	17	28"
162-168	13 1/2"	NO	17	27"
168-174	12 1/2"	NO	17	26"


A
B
C
ANTENNA ADAPTER
TRANSMISSION LINE ADAPTER

TYPE - CE DIRECTIONAL

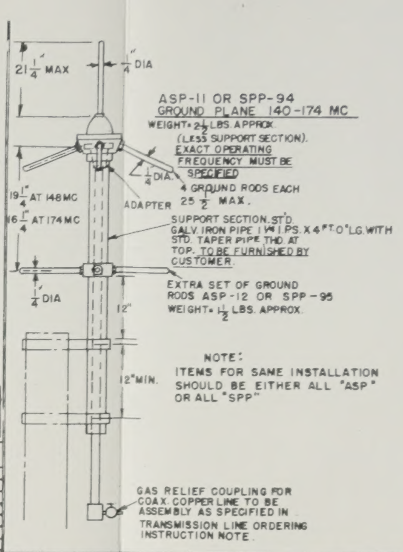
WEIGHT = SEE TABLE BELOW

EXACT OPERATING FREQ. MUST BE SPECIFIED

END SEAL FOR CO-AX COPPER LINE TO BE ASSEMBLED AS SPECIFIED IN TRANSM. LINE ORDERING INSTRUCTION NOTE.

UNIVERSAL TYPE MOUNTING BRACKETS & CLAMPS TO PERMIT MOUNTING TO A 2" O.D. PIPE OR TO A 2" X 2" ANGLE, FURNISHED WITH ANTENNA. MOUNT BRACKETS AS FAR APART AS POSSIBLE.

FREQ. RANGE (MC)	AVERAGE WIDTH A	AVERAGE HEIGHT B	AVERAGE DEPTH C	AVERAGE WEIGHT IN LBS
35-40	13 FT	13 FT	11 FT 6"	140
40-50	10 FT	10 FT	9 FT	105
72-76	7 FT	7 FT	6 FT	50
150-170	3 FT 6"	3 FT 6"	3 FT	23


$21\frac{1}{4}$" MAX
$\frac{1}{4}$" DIA
$\frac{1}{4}$" DIA.
ADAPTER
$19\frac{1}{4}$" AT 148 MC
$16\frac{1}{4}$" AT 174 MC
$\frac{1}{4}$" DIA
12"
12" MIN.
4 GROUND RODS EACH $25\frac{1}{2}$" MAX.
SUPPORT SECTION. ST'D. GALV. IRON PIPE 1 1/4" I.P.S. X 4 FT. 0" LG. WITH STD. TAPER PIPE THD. AT TOP. TO BE FURNISHED BY CUSTOMER.
EXTRA SET OF GROUND RODS ASP-12 OR SPP-95 WEIGHT = $1\frac{1}{2}$ LBS. APPROX.
GAS RELIEF COUPLING FOR COAX. COPPER LINE TO BE ASSEMBLY AS SPECIFIED IN TRANSMISSION LINE ORDERING INSTRUCTION NOTE.

ASP-11 OR SPP-94 GROUND PLANE 140-174 MC

WEIGHT = $2\frac{1}{2}$ LBS. APPROX. (LESS SUPPORT SECTION). EXACT OPERATING FREQUENCY MUST BE SPECIFIED

NOTE: ITEMS FOR SAME INSTALLATION SHOULD BE EITHER ALL "ASP" OR ALL "SPP"

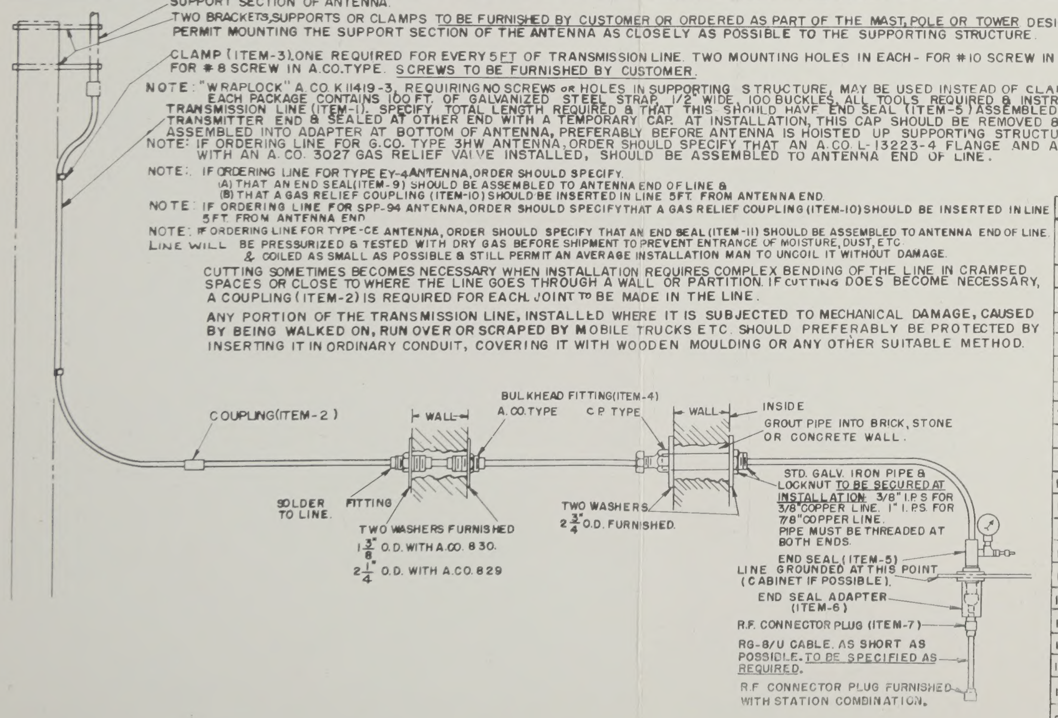
ORDER ANTENNA MODEL LISTED UNDER TYPE OF TRANSMISSION LINE TO BE USED. ADAPTERS MUST ALSO BE ORDERED EXCEPT WHEN REFERENCE IS MARKED WITH AN ASTERISK (*). WHEN SO MARKED, ADAPTERS ARE INCLUDED WITH THE ANTENNA.

7/8" O.D. COPPER 72-OHM	3/8" O.D. COPPER 72-OHM	RG-8/U	RG-17/U	7/8" O.D. COPPER 72-OHM	3/8" O.D. COPPER 72-OHM	RG-8/U	RG-17/U	7/8" O.D. COPPER 50 OHM			RG-17/U				
4EY2A2	4EY2A1	4EY2A8	4EY2A9												
4EY2A2	4EY2A1	4EY2A8	4EY2A9												
4EY2A2	4EY2A1	4EY2A8	4EY2A9												
				4EY2B2	4EY2B3	4EY2B4	4EY2B5	3HW-3			3HW-3				
				4EY2B2	4EY2B3	4EY2B4	4EY2B5	3HW-1			3HW-1				
				4EY2B2	4EY2B3	4EY2B4	4EY2B5	3HW-1			3HW-1				
				4EY2B2	4EY2B3	4EY2B4	4EY2B5	3HW-2			3HW-2				
				4EY2B2	4EY2B3	4EY2B4	4EY2B5	3HW-2			3HW-2				
COUPLING CP.501-28	COUPLING CP.503-2	JACK * UG-23B/U	JACK * UG-23B/U	BDR-1262 *	BDR-1270 *	BDP-2422-G102 *	BDP-2426-G102 *	NONE REQUIRED			SA-10				
		PLUG * UG-21B/U	PLUG * UG-167A/U WITH LONG PI	NONE	NONE	PLUG UG-21A/U *	PLUG IPC-3350 *	SEE TRANSM. LINE ORDERING INFORM.			UG-154/U				

FREQ. RANGE & ADAPTERS	7/8" O.D. COPPER 64-OHM	3/8" O.D. COPPER 70-OHM	RG-8/U	RG-17/U	7/8" O.D. COPPER 51.5 OHM	FREQ. RANGE FOR TYPE-CE ONLY	RG-8/U	RG-17/U	7/8" O.D. COPPER 64-OHM		RG-8/U	RG-17/U	
25-30 MC	4EY4C1	4EY4C2	4EY4C5	4EY4C6									
30-44 MC	4EY4A1	4EY4A2	4EY4A5	4EY4A6	CE-268 (7/8")	35-40 MC	CE-268 (RG-8/U)	CE-268 (RG-17/U)					
44-50 MC SEE NOTE 5	4EY4B1	4EY4B2	4EY4B5	4EY4B6	CE-269 (7/8")	40-50 MC	CE-269 (RG-8/U)	CE-269 (RG-17/U)					
72-76 MC	4EY4D1	4EY4D2	4EY4D5	4EY4D6	CE-274 (7/8")	72-76 MC	CE-274 (RG-8/U)	CE-274 (RG-17/U					
SEE NOTE 4 148-152 MC	4EY4E1	4EY4E2	4EY4E5	4EY4E6	CE-286 (7/8")	150-170 MC	CE-286 (RG-8/U)	CE-286 (RG-17/U)	SPP-94 OR ASP-11		ASP-11 OR SPP-94	ASP-11 OR SPP-94	
152-157 MC	4EY4F1	4EY4F2	4EY4F5	4EY4F6									
157-162 MC	4EY4G1	4EY4G2	4EY4G5	4EY4G6									
162-168 MC	4EY4H1	4EY4H2	4EY4H5	4EY4H6									
168-174 MC	4EY4J1	4EY4J2	4EY4J5	4EY4J6									
ANTENNA ADAPTER	A.CO G-901 *	A.CO F-901 *	A.CO SN-901 *	A.CO SC-901 *	PLUG UG-21C/U *		PLUG UG-21C/U *	SEE NOTE 3	SPP-100 OR ASP-15		ASP-13 OR SPP-96	ASP-14 OR SPP-97	
TRANSM. LINE ADAPTER	ORDER END SEAL WITH TRANSM. LINE	ORDER END SEAL WITH TRANSM. LINE	PLUG * UG-21B/U	PLUG * UG-154/U	SEE NOTE 1 SEE NOTE 2		JACK * UG-23A/U		COUPLING A.CO. 8328-B		PL-259 PLUG	NONE	

NOTE:

1. ADAPTER CP. 501-190 LESS UG-21/U PLUG
2. ORDER END SEAL WITH TRANSM. LINE
3. PLUG UG-59B/U * WITH LONG PIN JACK UG-333/U *
4. FOR 3HW-3, RANGE IS 144-152 MC FOR ASP-11, RANGE IS 140-174 MC SPECIFY SPPE-94, INSTEAD OF SPP-94, FOR 140-148 MC
5. FOR TYPE EY-2-A, RANGE IS 25-54 MC.


COUPLING (ITEM-2)
SOLDER TO LINE.
FITTING
WALL
BULKHEAD FITTING (ITEM-4)
A.CO. TYPE
C.P. TYPE
WALL
INSIDE
GROUT PIPE INTO BRICK, STONE OR CONCRETE WALL.
TWO WASHERS FURNISHED $1\frac{3}{8}$" O.D. WITH A.CO. 830. $2\frac{1}{4}$" O.D. WITH A.CO. 829
TWO WASHERS $2\frac{3}{4}$" O.D. FURNISHED.
STD. GALV. IRON PIPE & LOCKNUT TO BE SECURED AT INSTALLATION: 3/8" I.P.S FOR 3/8" COPPER LINE. 1" I.P.S. FOR 7/8" COPPER LINE. PIPE MUST BE THREADED AT BOTH ENDS.
END SEAL (ITEM-5)
LINE GROUNDED AT THIS POINT (CABINET IF POSSIBLE).
END SEAL ADAPTER (ITEM-6)
R.F. CONNECTOR PLUG (ITEM-7)
RG-8/U CABLE. AS SHORT AS POSSIBLE. TO BE SPECIFIED AS REQUIRED.
R.F. CONNECTOR PLUG FURNISHED WITH STATION COMBINATION.

SUPPORT SECTION OF ANTENNA.

TWO BRACKETS, SUPPORTS OR CLAMPS TO BE FURNISHED BY CUSTOMER OR ORDERED AS PART OF THE MAST, POLE OR TOWER DESIGN SHOULD PERMIT MOUNTING THE SUPPORT SECTION OF THE ANTENNA AS CLOSELY AS POSSIBLE TO THE SUPPORTING STRUCTURE.

CLAMP (ITEM-3). ONE REQUIRED FOR EVERY 5 FT OF TRANSMISSION LINE. TWO MOUNTING HOLES IN EACH- FOR #10 SCREW IN CP. TYPE- FOR #8 SCREW IN A.CO. TYPE. SCREWS TO BE FURNISHED BY CUSTOMER.

NOTE: "WRAPLOCK" A.CO. K11419-3, REQUIRING NO SCREWS OR HOLES IN SUPPORTING STRUCTURE, MAY BE USED INSTEAD OF CLAMPS. EACH PACKAGE CONTAINS 100 FT. OF GALVANIZED STEEL STRAP, 1/2" WIDE, 100 BUCKLES, ALL TOOLS REQUIRED & INSTRUCTIONS.

TRANSMISSION LINE (ITEM-1). SPECIFY TOTAL LENGTH REQUIRED & THAT THIS SHOULD HAVE END SEAL (ITEM-5) ASSEMBLED TO TRANSMITTER END & SEALED AT OTHER END WITH A TEMPORARY CAP. AT INSTALLATION, THIS CAP SHOULD BE REMOVED & DISCARDED. LINE SHOULD THEN BE ASSEMBLED INTO ADAPTER AT BOTTOM OF ANTENNA, PREFERABLY BEFORE ANTENNA IS HOISTED UP SUPPORTING STRUCTURE.

NOTE: IF ORDERING LINE FOR G.CO. TYPE 3HW ANTENNA, ORDER SHOULD SPECIFY THAT AN A.CO. L-13223-4 FLANGE AND AN A.CO. 1350 GAS INLET COUPLING, WITH AN A.CO. 3027 GAS RELIEF VALVE INSTALLED, SHOULD BE ASSEMBLED TO ANTENNA END OF LINE.

NOTE: IF ORDERING LINE FOR TYPE EY-4 ANTENNA, ORDER SHOULD SPECIFY.
(A) THAT AN END SEAL (ITEM-9) SHOULD BE ASSEMBLED TO ANTENNA END OF LINE &
(B) THAT A GAS RELIEF COUPLING (ITEM-10) SHOULD BE INSERTED IN LINE 5 FT. FROM ANTENNA END.

NOTE: IF ORDERING LINE FOR SPP-94 ANTENNA, ORDER SHOULD SPECIFY THAT A GAS RELIEF COUPLING (ITEM-10) SHOULD BE INSERTED IN LINE 5 FT. FROM ANTENNA END

NOTE: IF ORDERING LINE FOR TYPE-CE ANTENNA, ORDER SHOULD SPECIFY THAT AN END SEAL (ITEM-11) SHOULD BE ASSEMBLED TO ANTENNA END OF LINE.

LINE WILL BE PRESSURIZED & TESTED WITH DRY GAS BEFORE SHIPMENT TO PREVENT ENTRANCE OF MOISTURE, DUST, ETC. & COILED AS SMALL AS POSSIBLE & STILL PERMIT AN AVERAGE INSTALLATION MAN TO UNCOIL IT WITHOUT DAMAGE.

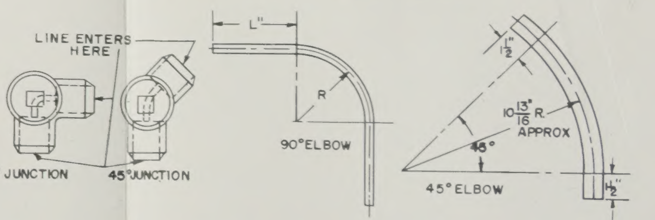
CUTTING SOMETIMES BECOMES NECESSARY WHEN INSTALLATION REQUIRES COMPLEX BENDING OF THE LINE IN CRAMPED SPACES OR CLOSE TO WHERE THE LINE GOES THROUGH A WALL OR PARTITION. IF CUTTING DOES BECOME NECESSARY, A COUPLING (ITEM-2) IS REQUIRED FOR EACH JOINT TO BE MADE IN THE LINE.

ANY PORTION OF THE TRANSMISSION LINE, INSTALLED WHERE IT IS SUBJECTED TO MECHANICAL DAMAGE, CAUSED BY BEING WALKED ON, RUN OVER OR SCRAPED BY MOBILE TRUCKS ETC. SHOULD PREFERABLY BE PROTECTED BY INSERTING IT IN ORDINARY CONDUIT, COVERING IT WITH WOODEN MOULDING OR ANY OTHER SUITABLE METHOD.

TRANSMISSION LINE & FITTINGS

	ITEM / TYPE OF LINE	7/8" SOFT DRAWN O.D. GAS FILLED COPPER				3/8" SOFT DRAWN O.D. GAS FILLED COPPER		52 OHM SOLID DIELECTRIC	
		50 OHM	51.5 OHM	64 OHM	72 OHM	70 OHM	72 OHM	RG-8/U	RG-17/U
1	TRANSMISSION LINE	A.CO. S-450	CP.501-121	A.CO. 737	CP. 502-1	A.CO. 83	CP. 503-1	RG-8/U	RG-17/U
2	COUPLING	A.CO. K-12385	CP. 501-28	A.CO. 8328-B	CP. 501-28	A.CO. 8319	CP. 503-2	UG-21A/U & UG-23A/U	49550 & 49579
3	CLAMP	A.CO. 6104	CP. 501-14	A.CO. 6104	CP. 501-14	A.CO. 6102	CP. 503-6	A.CO. 6102 OR CP. 503-6	A.CO. 6104 OR CP. 501-14
4	BULKHEAD FITTING	A.CO. 829 2 REQUIRED	CP. S-12689	A.CO. 829 2 REQUIRED	CP. S-12689	A.CO. 830 2 REQUIRED	CP. S-12688		
5	END SEAL, INCLUDING GAUGE & GAS ADMISSION VALVE	A.CO. L-12374	CP. 501-9	A.CO. 1703-GV	CP. 501-9	A.CO. 1701-GV	CP. 503-4		
6	END SEAL ADAPTER	A.CO. L-12394	CP. 501-45	A.CO. L-12394	CP. 501-45	A.CO. 4868	CP. 503-12		
7	R.F. CONNECTOR PLUG	PL-259	PL-259 FURNISHED WITH ITEM-6	PL-259	PL-259 FURNISHED WITH ITEM-6	PL-259	PL-259 FURNISHED WITH ITEM-6		
8	REDUCING COUPLING RG-17/U TO RG-8/U								AMPHENOL 82-56 & 82-38 WITH 82-1006 CONTACT
9	END SEAL FOR USE WITH TYPE EY-4 ANTENNA			A.CO. 1703-P		A.CO. 1701-P			
10	GAS RELIEF COUPLING			A.CO. 917-R		A.CO. 915-R			
11	END SEAL, INCLUDING BLEEDER VALVE		CP. 501-51 BV	A.CO. 1703-R	CP. 501-51 BV				
12									
13									
14	MINIMUM BEND RADIUS OF LINE	12"	30"	12"	30"	6"	8"	$4\frac{1}{2}$"	10"
15	WEIGHT OF LINE PER 100 FT.	50#	60#	50#	60#	16#	16#	12#	49#
16									
17									
18	REPLACEMENT GAS RELIEF VALVE	A.CO. 3027	CP. 507-10	A.CO. 3027	CP. 507-10	A.CO. 3027	CP. 507-10		
19	REPLACEMENT GAS ADMISSION VALVE	A.CO. 3017	CP. 507-12	A.CO. 3017	CP. 507-12	A.CO. 3017	CP. 507-12		
20	REPLACEMENT PRESSURE GAUGE	A.CO. 3500	CP. 507-1	A.CO. 3500	CP. 507-1	A.CO. 3500	CP. 507-1		

FITTINGS AVAILABLE FOR SPECIAL APPLICATION OR WHERE MINIMUM BENDING RADIUS IS TOO GREAT FOR SATISFACTORY INSTALLATION OF 7/8" O.D. TRANSMISSION LINE, ARE SHOWN BELOW.

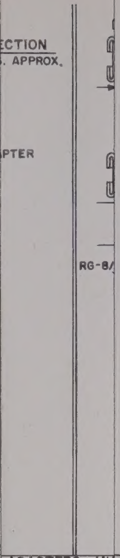

LINE ENTERS HERE
90° JUNCTION
45° JUNCTION
L"
R
90° ELBOW
$1\frac{1}{2}$"
$10\frac{13}{16}$" R. APPROX
45°
45° ELBOW
$1\frac{1}{2}$"

TYPE OF 7/8" O.D LINE	90° JUNCTION	45° JUNCTION	90° ELBOW	45° ELBOW
64-OHM	A.CO. 61	A.CO. 403	A.CO. 6500. R = 12" L = 9" 2 SOLDER-TYPE A.CO. 8328-B COUPLINGS FURNISHED FOR JOINING TO LINE.	
51.5-OHM	CP. 501-76		CP. 501-80 R = $5\frac{3}{8}$" L = $1\frac{1}{2}$" 2 SOLDER-TYPE CP. 501-28 COUPLINGS REQUIRED FOR JOINING TO LINE	
72-OHM	CP. 501-32		CP. 501-42 R = $5\frac{3}{8}$" L = $1\frac{1}{2}$" 2 SOLDER-TYPE CP. 501-28 COUPLINGS REQUIRED FOR JOINING TO LINE.	CP. 501-43 2 SOLDER-TYPE CP. 501-28 COUPLINGS REQUIRED FOR JOINING TO LINE.

Installation Diagram

25-50 MC, 72-76 MC, AND 144-174 MC STATION ANTENNAS

(D-7667600, Sheet 1, Rev. 9)



NOTES

20 AT 450-470 MC, USE RG-8/U ONLY FOR TEMPORARY INSTALLATION OR DEMONSTRATION.

21 FURNISHED AS PART OF ANTENNA.

22 THE FOLLOWING MOUNTING CLAMPS ARE AVAILABLE FOR ATTACHING TO A 3/4" I. P.S. SECTION TO A ROUND SUPPORTING STRUCTURE:

A.CO. 12688-1 FOR 2" I.P.S. STRUCTURE
A.CO. 12688-2 FOR 2½ I.P.S. STRUCTURE
A.CO. 12688-3 FOR 3" I.P.S. STRUCTURE

23 EXCEPT WITH INPUT TERMINAL UG-59 B/U, WITH LONG PIN, INSTEAD OF UG-21 B/U.

24 IN ORDER TO USE 7/8" COPPER CO-AX TRANSMISSION LINE WITH A.CO. TYPE 116 ANTENNA, A SHORT LENGTH OF RG-8/U CABLE WITH A UG-21B/U PLUG ON EACH END IS REQUIRED. THIS PIECE OF RG-8/U SHOULD BE AS SHORT AS POSSIBLE BUT STILL ALLOW IT TO BE CONNECTED BETWEEN THE PRESSURIZED ADAPTER ON THE TRANSMISSION LINE & THE UG-27B/U FITTING ON THE ANTENNA.

25 POWER LOSS VERSUS LENGTH OF TRANSMISSION LINE

CABLE	LOSS PER 100 FT. AT 450 MC	MAXIMUM RECOM. LENGTH	POWER LOSS AT MAX RECOM. LENGTH
RG-8/U	5.2 DB	SEE NOTE-20	30% AT 30 FEET 45% AT 50 FEET
RG-17/U	2.25 DB	60 FEET	27%
7/8 CO-AX COPPER (A.CO.738)	0.80 DB	200 FEET	31%

NOTE: FOR LINES LONGER THAN 200 FT, THE USE OF 1 5/8" O.D. LINE SHOULD BE CONSIDERED.

26 USE 1 JACK, UG-333/U (AMPHENOL 82-56) AND 1 PLUG, UG-59B/U WITH LONG PIN (AMPHENOL 82-804 WITH 82-1006 PIN)

ADAPTERS MU WHEN SO MAR			
- 8/U E NOTE-20	7/8" O.D		FREQ. RANGE & ADAPTERS
CO. 116	A.CO		450-470 MC
E NOTE-21	UG-2		ANTENNA ADAPTER
-27B/U & -21B/U	SEE T LINE O INFOR		TRANSM. LINE ADAPTER

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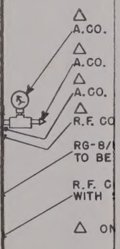
TRANSMISSION LINE & FITTINGS

ITEM	TYPE OF LINE	7/8" O.D. SOFT DRAWN, FLANGED CO-AX COPPER		52 OHM SOLID DI-ELECTRIC	
		53.5-OHM		RG-8/U	RG-17/U
1	TRANSMISSION LINE	A.CO. 738		RG-8/U	RG-17/U
2	COUPLING	A.CO.L-13223-3		UG-21B/U & UG-23B/U	49550 & 49579
3	CLAMP	A.CO. 6104		A.CO. 6102	A.CO. 6104
4					
5					
6					
7	R.F. CONNECTOR PLUG	UG-21B/U			
8	REDUCING COUPLING RG-17/U TO RG-8/U				SEE NOTE-26
9					
10					
11					
12					
13					
14	MINIMUM BEND RADIUS OF LINE	12"		4½"	10"
15	WEIGHT OF LINE PER 100 FT.	50#		12#	49#



Installation Diagram

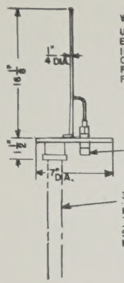
450-470 MC
STATION ANTENNAS

(D-7667600, Sheet 2, Rev. 6)

A. CO. TYPE 225
UNITY GAIN

WEIGHT = 2 LBS. APPROX.

UPPER END OF RADIATING ELEMENT TO BE CUT AT INSTALLATION FOR EXACT OPERATING FREQUENCY, FOLLOWING DIRECTIONS FURNISHED WITH EACH ANTENNA.

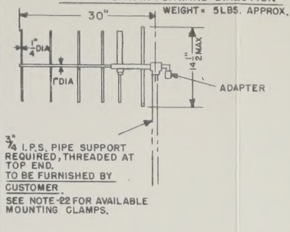


3/4" I.P.S. PIPE SUPPORT REQUIRED, THREADED AT TOP END TO BE FURNISHED BY CUSTOMER.

SEE NOTE-22 FOR AVAILABLE MOUNTING CLAMPS.

A. CO. TYPE 116
DIRECTIONAL (YAGI)
10 DB GAIN IN FORWARD DIRECTION

WEIGHT = 5LBS. APPROX.

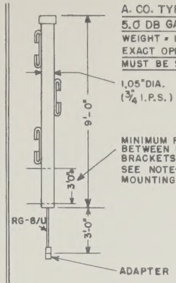


3/4" I.P.S. PIPE SUPPORT REQUIRED, THREADED AT TOP END.
TO BE FURNISHED BY CUSTOMER.

SEE NOTE-22 FOR AVAILABLE MOUNTING CLAMPS.

A. CO. TYPE 4002
5.0 DB GAIN

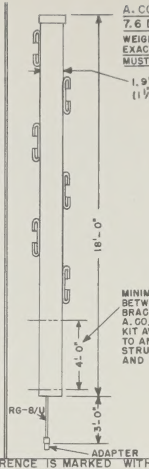
WEIGHT = 13 LBS. APPROX.
EXACT OPERATING FREQUENCY MUST BE SPECIFIED.



MINIMUM RECOMMENDED DISTANCE BETWEEN MOUNTING CLAMPS OR BRACKETS TO MAST OR TOWER.
SEE NOTE-22 FOR AVAILABLE MOUNTING CLAMPS.

A. CO. TYPE 4000
7.6 DB GAIN

WEIGHT = 80 LBS. APPROX.
EXACT OPERATING FREQUENCY MUST BE SPECIFIED



MINIMUM RECOMMENDED DISTANCE BETWEEN MOUNTING CLAMPS OR BRACKETS TO MAST OR TOWER, A. CO. L-14671-2 MOUNTING CLAMP KIT AVAILABLE FOR ATTACHING TO ANY ROUND SUPPORTING STRUCTURE BETWEEN 2" I.P.S. AND 3" I.P.S.

NOTES

20 AT 450-470 MC, USE RG-8/U ONLY FOR TEMPORARY INSTALLATION OR DEMONSTRATION.

21 FURNISHED AS PART OF ANTENNA.

22 THE FOLLOWING MOUNTING CLAMPS ARE AVAILABLE FOR ATTACHING TO A 3/4" I.P.S. SECTION TO A ROUND SUPPORTING STRUCTURE;
A.CO. 12688-1 FOR 2" I.P.S. STRUCTURE
A.CO. 12688-2 FOR 2 1/2 I.P.S. STRUCTURE
A.CO. 12688-3 FOR 3" I.P.S. STRUCTURE

23 EXCEPT WITH INPUT TERMINAL UG-59 B/U, WITH LONG PIN, INSTEAD OF UG-21 B/U.

24 IN ORDER TO USE 7/8 COPPER CO-AX TRANSMISSION LINE WITH A.CO. TYPE 116 ANTENNA, A SHORT LENGTH OF RG-8/U CABLE WITH A UG-21B/U PLUG ON EACH END IS REQUIRED. THIS PIECE OF RG-8/U SHOULD BE AS SHORT AS POSSIBLE BUT STILL ALLOW IT TO BE CONNECTED BETWEEN THE PRESSURIZED ADAPTER ON THE TRANSMISSION LINE & THE UG-27B/U FITTING ON THE ANTENNA.

25 POWER LOSS VERSUS LENGTH OF TRANSMISSION LINE

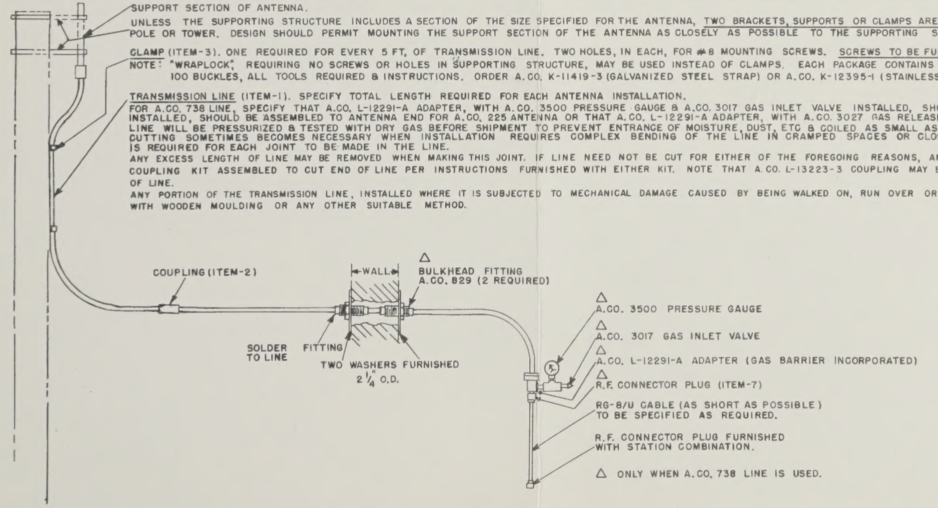
CABLE	LOSS PER 100 FT. AT 450 MC	MAXIMUM RECOM. LENGTH	POWER LOSS AT MAX RECOM. LENGTH
RG-8/U	5.2 DB	SEE NOTE-20	30% AT 30 FEET 45% AT 50 FEET
RG-17/U	2.25 DB	60 FEET	27%
7/8 CO-AX COPPER (A.CO.738)	0.80 DB	200 FEET	31%

NOTE: FOR LINES LONGER THAN 200 FT. THE USE OF 1 5/8 O.D. LINE SHOULD BE CONSIDERED.

26 USE 1 JACK, UG-333/U (AMPHENOL 82-56) AND 1 PLUG, UG-59B/U WITH LONG PIN (AMPHENOL 82-804 WITH 82-1006 PIN)

ORDER ANTENNA MODEL LISTED UNDER TYPE OF TRANSMISSION LINE TO BE USED. SEE NOTE-25. ADAPTERS MUST ALSO BE ORDERED EXCEPT WHEN REFERENCE IS MARKED WITH AN ASTERISK (*). WHEN SO MARKED, ADAPTERS ARE FURNISHED AS PART OF ANTENNA.

7/8" O.D. COPPER		RG-17/U	RG-8/U SEE NOTE-20	7/8" O.D. COPPER SEE NOTE 24		RG-17/U	RG-8/U SEE NOTE-20	7/8" O.D. COPPER		RG-17/U	RG-8/U SEE NOTE-20	7/8" O.D. COPPER		RG-17/U	RG-8/U SEE NOTE-20			FREQ. RANGE & ADAPTERS
A.CO. 225-1		A.CO. 225-2	A.CO. 225-2	A.CO. 116		A.CO. 116	A.CO. 116	A.CO. 4002		A.CO. 4002 SEE NOTE-23	A.CO. 4002	A.CO. 4000		A.CO. 4000 SEE NOTE-23	A.CO. 4000			450-470 MC
SEE NOTE-21		SEE NOTE-21	SEE NOTE-21	SEE NOTE-21		SEE NOTE-21	SEE NOTE-21	UG-21B/U *		UG-59B/U * WITH LONG PIN	UG-21B/U *	UG-21B/U *		UG-59B/U * WITH LONG PIN	UG-21B/U *			ANTENNA ADAPTER
SEE TRANSM. LINE ORDERING INFORMATION		A7144136P1	UG-21B/U	UG-27B/U ALSO SEE TRANSM. LINE ORDERING INFORMATION		UG-27B/U & A7144136P1	UG-27B/U & UG-21B/U	SEE TRANSM. LINE ORDERING INFORMATION		UG-333/U	UG-23B/U	SEE TRANSM. LINE ORDERING INFORMATION		UG-333/U	UG-23B/U			TRANSM. LINE ADAPTER


COUPLING (ITEM-2)
WALL
BULKHEAD FITTING
A.CO. 829 (2 REQUIRED)
SOLDER TO LINE
FITTING
TWO WASHERS FURNISHED
2 1/4" O.D.
A.CO. 3500 PRESSURE GAUGE
A.CO. 3017 GAS INLET VALVE
A.CO. L-12291-A ADAPTER (GAS BARRIER INCORPORATED)
R.F. CONNECTOR PLUG (ITEM-7)
RG-8/U CABLE (AS SHORT AS POSSIBLE) TO BE SPECIFIED AS REQUIRED.
R.F. CONNECTOR PLUG FURNISHED WITH STATION COMBINATION.
△ ONLY WHEN A.CO. 738 LINE IS USED.

SUPPORT SECTION OF ANTENNA.

UNLESS THE SUPPORTING STRUCTURE INCLUDES A SECTION OF THE SIZE SPECIFIED FOR THE ANTENNA, TWO BRACKETS, SUPPORTS OR CLAMPS ARE REQUIRED. THESE MAY BE ORDERED PER ANTENNA NOTES (ABOVE), FURNISHED BY THE CUSTOMER OR ORDERED WITH MAST, POLE OR TOWER. DESIGN SHOULD PERMIT MOUNTING THE SUPPORT SECTION OF THE ANTENNA AS CLOSELY AS POSSIBLE TO THE SUPPORTING STRUCTURE.

CLAMP (ITEM-3). ONE REQUIRED FOR EVERY 5 FT. OF TRANSMISSION LINE. TWO HOLES, IN EACH, FOR #8 MOUNTING SCREWS. SCREWS TO BE FURNISHED BY CUSTOMER.
NOTE: "WRAPLOCK", REQUIRING NO SCREWS OR HOLES IN SUPPORTING STRUCTURE, MAY BE USED INSTEAD OF CLAMPS. EACH PACKAGE CONTAINS 100 FEET OF 1/2" WIDE STRAP, 100 BUCKLES, ALL TOOLS REQUIRED & INSTRUCTIONS. ORDER A.CO. K-11419-3 (GALVANIZED STEEL STRAP) OR A.CO. K-12395-1 (STAINLESS STEEL STRAP).

TRANSMISSION LINE (ITEM-1). SPECIFY TOTAL LENGTH REQUIRED FOR EACH ANTENNA INSTALLATION.
FOR A.CO. 738 LINE, SPECIFY THAT A.CO. L-12291-A ADAPTER, WITH A.CO. 3500 PRESSURE GAUGE & A.CO. 3017 GAS INLET VALVE INSTALLED, SHOULD BE ASSEMBLED TO TRANSMITTER END AND THAT A.CO. 1350 GAS INLET COUPLING, WITH A.CO. 3027 GAS RELEASE VALVE INSTALLED, SHOULD BE ASSEMBLED TO ANTENNA END FOR A.CO. 225 ANTENNA OR THAT A.CO. L-12291-A ADAPTER, WITH A.CO. 3027 GAS RELEASE VALVE INSTALLED, SHOULD BE ASSEMBLED TO ANTENNA END FOR A.CO. 116, 4000 OR 4002 ANTENNA.
LINE WILL BE PRESSURIZED & TESTED WITH DRY GAS BEFORE SHIPMENT TO PREVENT ENTRANCE OF MOISTURE, DUST, ETC & COILED AS SMALL AS POSSIBLE & STILL PERMIT AN AVERAGE INSTALLATION MAN TO UNCOIL IT WITHOUT DAMAGE.
CUTTING SOMETIMES BECOMES NECESSARY WHEN INSTALLATION REQUIRES COMPLEX BENDING OF THE LINE IN CRAMPED SPACES OR CLOSE TO WHERE THE LINE GOES THROUGH A WALL OR PARTITION. IF CUTTING DOES BECOME NECESSARY, A COUPLING (ITEM-2) IS REQUIRED FOR EACH JOINT TO BE MADE IN THE LINE.
ANY EXCESS LENGTH OF LINE MAY BE REMOVED WHEN MAKING THIS JOINT. IF LINE NEED NOT BE CUT FOR EITHER OF THE FOREGOING REASONS, ANY EXCESS LENGTH OF LINE MAY BE CUT OFF ONE END AND EITHER A.CO. L-13223-4 FLANGE KIT, OR PART OF A.CO. L-13223-3 COUPLING KIT ASSEMBLED TO CUT END OF LINE PER INSTRUCTIONS FURNISHED WITH EITHER KIT. NOTE THAT A.CO. L-13223-3 COUPLING MAY BE USED WHEN CUTTING, SHORTENING, OR BOTH, ARE REQUIRED. A.CO. L-13223-4 FLANGE IS FOR USE ONLY WHEN CUTTING OFF END OF LINE.
ANY PORTION OF THE TRANSMISSION LINE, INSTALLED WHERE IT IS SUBJECTED TO MECHANICAL DAMAGE CAUSED BY BEING WALKED ON, RUN OVER OR SCRAPED BY MOBILE TRUCKS, ETC., SHOULD PREFERABLY BE PROTECTED BY INSERTING IT IN ORDINARY CONDUIT, COVERING IT WITH WOODEN MOULDING OR ANY OTHER SUITABLE METHOD.

FOR PRESSURIZATION OF COAXIAL COPPER TRANSMISSION LINE, A.CO. 878 HAND-OPERATED PUMP IS AVAILABLE. THIS PUMP CONTAINS INDICATING SILICA-GEL DESSICANT, EASILY REACTIVATED. OUTPUT OF PUMP IS 26 CUBIC INCHES PER STROKE, RECOMMENDED FOR PRESSURIZING 7/8 INCH LINES UP TO 1000 FT. IN LENGTH.

TRANSMISSION LINE & FITTINGS

ITEM	TYPE OF LINE	7/8" O.D. SOFT DRAWN, FLANGED CO-AX COPPER		52 OHM SOLID DI-ELECTRIC	
		53.5-OHM		RG-8/U	RG-17/U
1	TRANSMISSION LINE	A.CO. 738		RG-8/U	RG-17/U
2	COUPLING	A.CO. L-13223-3		UG-21B/U & UG-23B/U	49550 & 49579
3	CLAMP	A.CO. 6104		A.CO. 6102	A.CO. 6104
4					
5					
6					
7	R.F. CONNECTOR PLUG	UG-21B/U			
8	REDUCING COUPLING RG-17/U TO RG-8/U				SEE NOTE-26
9					
10					
11					
12					
13					
14	MINIMUM BEND RADIUS OF LINE	12"		4 1/2"	10"
15	WEIGHT OF LINE PER 100 FT.	50#		12#	49#

Installation Diagram

450-470 MC
STATION ANTENNAS

(D-7667600, Sheet 2, Rev. 6)

470 MC, THE FOLLOWING TRANSMISSION LINE LENGTHS LIMIT LOSS
TO APPROX. 30% (1.6 DB TOTAL ATTENUATION).

H	TYPE
X.	RG-8/U (ATTENUATION APPROX. 5.4 DB PER 100 FT.)
X.	RG-17/U (ATTENUATION APPROX. 2.3 DB PER 100 FT.)
X.	AIR-DIELECTRIC LINE WITH MAX. ATTENUATION OF 1.0 DB PER 100 FT.
X.	AIR-DIELECTRIC LINE WITH MAX. ATTENUATION OF .85 DB PER 100 FT.
FT.	$1\frac{5}{8}$" O.D. AIR-DIELECTRIC LINE.

INES MAY BE USED IF INCREASE IN LOSS OF POWER CAN BE
D.

SS CAN BE REDUCED BY USING A LINE WITH LOWER ATTENUATION.

Installation Diagram

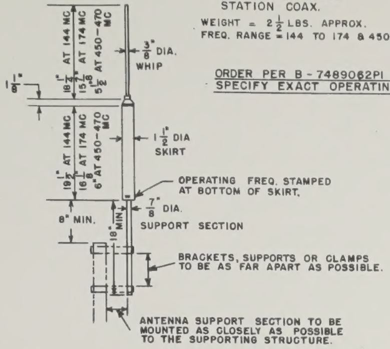
25-50 MC, 144-174 MC AND
450-470 MC STATION ANTENNAS

(D-7667600, Sheet 3, Rev. 2)

P-M TYPE S-3BB
STATION COAX.

WEIGHT = 2 1/2 LBS. APPROX.
FREQ. RANGE = 144 TO 174 & 450 TO 470 MC.

ORDER PER B-7489062P1 & SPECIFY EXACT OPERATING FREQ.


18 1/4" AT 144 MC
15 7/8" AT 174 MC
5 1/2" AT 450-470 MC
3/8" DIA. WHIP
1 1/8"
19 1/2" AT 144 MC
16 1/8" AT 174 MC
6" AT 450-470 MC
1 1/2 DIA SKIRT
OPERATING FREQ. STAMPED AT BOTTOM OF SKIRT.
7/8" DIA. SUPPORT SECTION
8" MIN.
18" MIN
BRACKETS, SUPPORTS OR CLAMPS TO BE AS FAR APART AS POSSIBLE.
ANTENNA SUPPORT SECTION TO BE MOUNTED AS CLOSELY AS POSSIBLE TO THE SUPPORTING STRUCTURE.

RG-8/U TRANSMISSION LINE* CONNECTS DIRECTLY TO ANTENNA WITHOUT ADDITIONAL MATERIAL OR ANY SOLDERING PER INSTALLATION INSTRUCTIONS, INCLUDED WITH EACH ANTENNA.

TO CONNECT RG-17/U TRANSMISSION LINE* TO THE ANTENNA, THE FOLLOWING ADDITIONAL MATERIAL IS REQUIRED.

(A) 6FT. RG-8/U CABLE. ATTACH TO ANTENNA PER INSTRUCTIONS FURNISHED.
(B) 1-UG-59A/U PLUG WITH LONG PIN (AMPHENOL 82-38 WITH 82-1006 PIN). ATTACH TO BOTTOM OF RG-8/U CABLE.
(C) 1-UG-333/U JACK (AMPHENOL 82-56). ATTACH TO TOP OF RG-17/U TRANSMISSION LINE.

TO CONNECT AIR-DIELECTRIC TRANSMISSION LINE* TO THE ANTENNA, THE FOLLOWING ADDITIONAL MATERIAL IS REQUIRED:

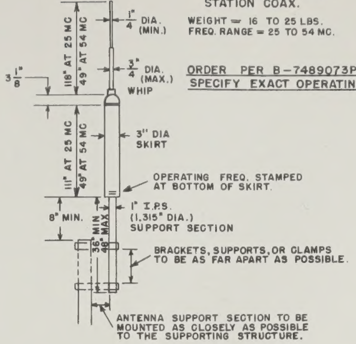
(A) 6FT. RG-8/U CABLE. ATTACH TO ANTENNA PER INSTRUCTIONS FURNISHED.
(B) END SEAL FOR TRANSMISSION LINE
ADAPTER - END SEAL TO TYPE-N
TYPE-N PLUG FOR ADAPTER
(TO BE ATTACHED TO BOTTOM OF RG-8/U CABLE) — ORDER WITH TRANSMISSION LINE

* SEE NOTE-30

P-M TYPE S-4CB
STATION COAX.

WEIGHT = 16 TO 25 LBS.
FREQ. RANGE = 25 TO 54 MC.

ORDER PER B-7489073P1 & SPECIFY EXACT OPERATING FREQ.


118" AT 25 MC
49" AT 54 MC
1/4" DIA. (MIN.)
3/4" DIA. (MAX.) WHIP
3 1/8"
111" AT 25 MC
49" AT 54 MC
3" DIA SKIRT
OPERATING FREQ. STAMPED AT BOTTOM OF SKIRT.
1" I.P.S. (1.315" DIA.) SUPPORT SECTION
8" MIN.
36" MIN
48" MAX
BRACKETS, SUPPORTS, OR CLAMPS TO BE AS FAR APART AS POSSIBLE.
ANTENNA SUPPORT SECTION TO BE MOUNTED AS CLOSELY AS POSSIBLE TO THE SUPPORTING STRUCTURE.

RG-8/U TRANSMISSION LINE CONNECTS DIRECTLY TO ANTENNA WITHOUT ADDITIONAL MATERIAL OR ANY SOLDERING PER INSTALLATION INSTRUCTIONS, INCLUDED WITH EACH ANTENNA.

TO CONNECT RG-17/U TRANSMISSION LINE TO THE ANTENNA, THE FOLLOWING ADDITIONAL MATERIAL IS REQUIRED.

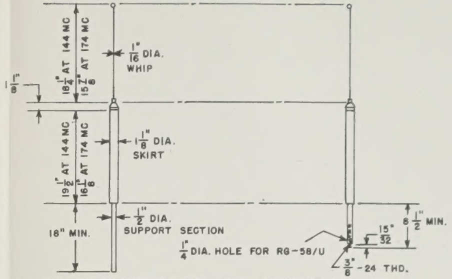
(A) 14 FT. RG-8/U CABLE. AFTER ATTACHING TOP END TO ANTENNA PER PER INSTRUCTIONS FURNISHED, CUT OFF CABLE EXTENDING MORE THAN 3FT. BELOW ANTENNA SUPPORT SECTION.
(B) 1-UG-59A/U PLUG WITH LONG PIN (AMPHENOL 82-38 WITH 82-1006 PIN). ATTACH TO BOTTOM OF RG-8/U CABLE.
(C) 1-UG-333/U JACK (AMPHENOL 82-56). ATTACH TO TOP OF RG-17/U TRANSMISSION LINE.

TO CONNECT AIR DIELECTRIC TRANSMISSION LINE TO THE ANTENNA, THE FOLLOWING ADDITIONAL MATERIAL IS REQUIRED:

(A) 14 FT. RG-8/U CABLE, AFTER ATTACHING TOP END TO ANTENNA PER INSTRUCTIONS FURNISHED, CUT OFF CABLE EXTENDING MORE THAN 3 FT. BELOW ANTENNA SUPPORT SECTION.
(B) END SEAL FOR TRANSMISSION LINE
ADAPTER - END SEAL TO TYPE-N
TYPE-N PLUG FOR ADAPTER
(TO BE ATTACHED TO BOTTOM OF RG-8/U CABLE). — ORDER WITH TRANSMISSION LINE

P-M TYPE M-1A MOBILE COAX.

WEIGHT = 1 1/2 LBS. APPROX.
FREQ. RANGE = 144 TO 174 MC.


18 1/4" AT 144 MC
15 7/8" AT 174 MC
1/16" DIA. WHIP
1 1/8"
19 1/2" AT 144 MC
16 1/8" AT 174 MC
1 1/8" DIA. SKIRT
1/2" DIA. SUPPORT SECTION
18" MIN.
1/4" DIA. HOLE FOR RG-58/U
15/32"
8 1/2" MIN.
3/8"-24 THD.

FOR MOUNTING TO BUMPER, SIDE OF CAR OR TRUCK BODY, ETC. CLAMPS, REQUIRED BUT NOT INCLUDED, SHOULD BE MOUNTED AS FAR APART AS POSSIBLE.

LACQUERED BRASS (M-1AB-150)
ORDER PER B-7489077P1 & SPECIFY EXACT OPERATING FREQ.

CHROME PLATED BRASS (M-1AC-150)
ORDER PER B-7489077P2 & SPECIFY EXACT OPERATING FREQ.

FOR MOUNTING INTO STD. ANTENNA BASE, ML747288OG5 OR SPRING, ML747663263.

CHROME PLATED BRASS (M-1AC/A-150)
ORDER PER B-7489077P3 & SPECIFY EXACT OPERATING FREQ.

RG-58/U TRANSMISSION LINE CONNECTS DIRECTLY TO ANY OF THE ABOVE ANTENNAS WITHOUT ADDITIONAL MATERIAL OR ANY SOLDERING PER INSTALLATION INSTRUCTIONS, INCLUDED WITH EACH ANTENNA.

TO CONNECT RG-8/U TRANSMISSION LINE TO ANY OF THE ABOVE ANTENNAS, THE FOLLOWING ADDITIONAL MATERIAL IS REQUIRED:

(A) 6FT. RG-58/U CABLE. ATTACH TO ANTENNA PER INSTRUCTIONS FURNISHED.
(B) 2-PL-259 PLUGS
(C) 1-UG-175/U ADAPTER — SEE NOTE BELOW
(D) 1-PL-258 JUNCTION

NOTE: IF THE RG-8/U TO RG-58/U JUNCTION IS TO BE EXPOSED TO WEATHER, ITEMS B, C, & D SHOULD BE REPLACED WITH 1-UG-536/U PLUG & 1-UG-23/U JACK

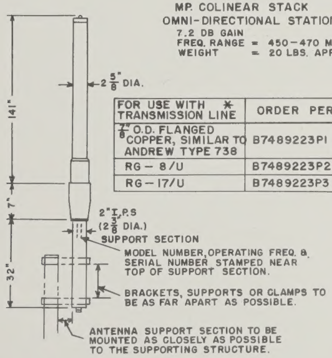
NOTE 30
AT 450 TO 470 MC, THE FOLLOWING TRANSMISSION LINE LENGTHS LIMIT LOSS OF POWER TO APPROX. 30% (1.6 DB TOTAL ATTENUATION).

LENGTH	TYPE
30 FT. MAX.	RG-8/U (ATTENUATION APPROX. 5.4 DB PER 100 FT.)
70 FT. MAX.	RG-17/U (ATTENUATION APPROX. 2.3 DB PER 100 FT.)
160 FT. MAX.	AIR-DIELECTRIC LINE WITH MAX. ATTENUATION OF 1.0 DB PER 100 FT.
190 FT. MAX.	AIR-DIELECTRIC LINE WITH MAX. ATTENUATION OF .85 DB PER 100 FT.
OVER 190 FT.	1 5/8" O.D. AIR-DIELECTRIC LINE.

LONGER LINES MAY BE USED IF INCREASE IN LOSS OF POWER CAN BE TOLERATED.
POWER LOSS CAN BE REDUCED BY USING A LINE WITH LOWER ATTENUATION.

MP. COLINEAR STACK
OMNI-DIRECTIONAL STATION ANTENNA

7.2 DB GAIN
FREQ. RANGE = 450-470 MC.
WEIGHT = 20 LBS. APPROX.


2 5/8" DIA.
141"
7'
32"
2" I.P.S (2 3/8" DIA.) SUPPORT SECTION
MODEL NUMBER, OPERATING FREQ. & SERIAL NUMBER STAMPED NEAR TOP OF SUPPORT SECTION.
BRACKETS, SUPPORTS OR CLAMPS TO BE AS FAR APART AS POSSIBLE.
ANTENNA SUPPORT SECTION TO BE MOUNTED AS CLOSELY AS POSSIBLE TO THE SUPPORTING STRUCTURE.

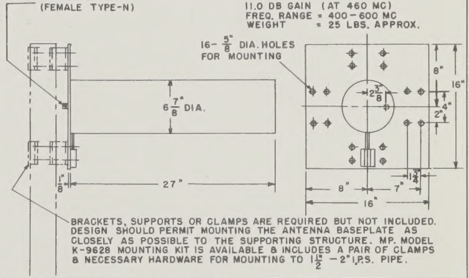
FOR USE WITH * TRANSMISSION LINE	ORDER PER	
7/8" O.D. FLANGED COPPER, SIMILAR TO ANDREW TYPE 738	B7489223P1	& SPECIFY EXACT
RG-8/U	B7489223P2	OPERATING
RG-17/U	B7489223P3	FREQUENCY

THE FOLLOWING ADDITIONAL MATERIAL IS REQUIRED FOR CONNECTING TRANSMISSION LINE TO ANTENNA.

FOR B7489223P1
FLANGE FITTING WITH PROVISION FOR BLEEDING LINE. ORDER WITH LINE.
FOR B7489223P2
1-UG-21B/U PLUG. ATTACH TO TOP OF RG-8/U TRANSMISSION LINE.
FOR B7489223P3
1-UG-154/U PLUG. ATTACH TO TOP OF RG-17/U TRANSMISSION LINE.

MP. HELICAL BEAM
STATION ANTENNA

11.0 DB GAIN (AT 460 MC)
FREQ. RANGE = 400-600 MC
WEIGHT = 25 LBS. APPROX.


RF CONNECTION (FEMALE TYPE-N)
16- 5/8" DIA. HOLES FOR MOUNTING
6 7/8" DIA.
27"
1/8"
2 3/8"
8"
16"
4"
2"
1 3/4"
8"
7"
16"

BRACKETS, SUPPORTS OR CLAMPS ARE REQUIRED BUT NOT INCLUDED. DESIGN SHOULD PERMIT MOUNTING THE ANTENNA BASEPLATE AS CLOSELY AS POSSIBLE TO THE SUPPORTING STRUCTURE. MP. MODEL K-9628 MOUNTING KIT IS AVAILABLE & INCLUDES A PAIR OF CLAMPS & NECESSARY HARDWARE FOR MOUNTING TO 1 1/2" - 2" I.P.S. PIPE.

FOR USE WITH * TRANSMISSION LINE	ORDER PER	
	FOR RIGHT HAND SENSE	FOR LEFT HAND SENSE
AIR-DIELECTRIC OR RG-8/U	B 7489391P1	B 7489391P2
RG-17/U	B 7489391P3	B 7489391P4

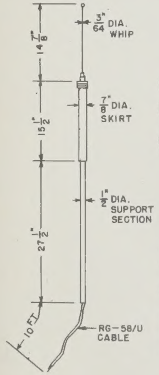
THE FOLLOWING ADDITIONAL MATERIAL IS REQUIRED FOR CONNECTING TRANSMISSION LINE TO ANTENNA.

FOR B 7489391P1 OR P2 AND AIR-DIELECTRIC TRANSMISSION LINE.
(A) 3 FT. RG-8/U CABLE WITH A UG-21B/U PLUG ATTACHED AT EACH END.
(B) END SEAL FOR TRANSMISSION LINE
(C) ADAPTER — END SEAL TO TYPE-N } ORDER WITH TRANSMISSION LINE.
FOR B 7489391P1 OR P2 AND RG-8/U TRANSMISSION LINE.
1 — UG-21B/U PLUG, ATTACH TO TOP OF LINE.
FOR B 7489391P3 OR P4 AND RG-17/U TRANSMISSION LINE.
1 — UG-154/U PLUG, ATTACH TO TOP OF LINE.

* SEE NOTE 30

MP. COLINEAR ARRAY
MOBILE COAX.

3.0 DB GAIN
FREQ. RANGE = 450—470 MC
WEIGHT = 1 3/4 LBS. APPROX.


3/64" DIA. WHIP
14 7/8"
7/8" DIA. SKIRT
15 1/2"
1/2" DIA. SUPPORT SECTION
27 1/2"
10 FT.
RG-58/U CABLE

ORDER PER B 7489390P1

FOR MOUNTING TO BUMPER, SIDE OF CAR OR TRUNK BODY, ETC. CLAMPS, REQUIRED BUT NOT INCLUDED, SHOULD BE MOUNTED AS FAR APART AS POSSIBLE.
NOTE: THIS ANTENNA MAY BE MOUNTED INTO STD. ANTENNA BASE ML747288OG5 OR SPRING ML747663263 BY USING A SPECIAL ADAPTER.

TO CONNECT RG-8/U TRANSMISSION LINE* TO THIS ANTENNA, THE RG-58/U CABLE SHOULD BE CUT OFF TO EXTEND APPROX. 3FT. BELOW SUPPORT SECTION & THE FOLLOWING MATERIAL IS REQUIRED TO COMPLETE THE JUNCTION BETWEEN THE RG-8/U & RG-58/U CABLES.

(A) 2 PL-259 PLUGS
(B) 1 UG-175/U ADAPTER } SEE NOTE BELOW
(C) 1 PL-258 JUNCTION

NOTE: IF THIS JUNCTION IS TO BE EXPOSED TO THE WEATHER, ITEMS A, B & C SHOULD BE REPLACED WITH 1 UG-536/U PLUG & 1 UG-23/U JACK.

* SEE NOTE 30

Installation Diagram

25-50 MC, 144-174 MC AND
450-470 MC STATION ANTENNAS

(D-7667600, Sheet 3, Rev. 2)

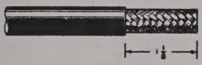
A 7135401

INSTRUCTIONS

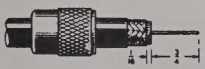
FIRST MADE FOR GENERAL USE

FOR ASSEMBLY OF 83 SERIES, TYPE UHF PLUGS

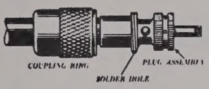
ASSEMBLY OF CABLES TO 83-1SP PLUG



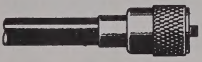
Cut end of cable even.
Remove vinyl jacket 1 1/8"—*don't nick braid.*



Bare 3/4" of center conductor—*don't nick conductor.*
Trim braided shield 1/16" and trim.
Slide coupling ring on cable.

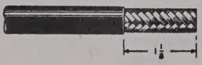

COUPLING RING
PLUG ASSEMBLY
SOLDER HOLE

Screw the plug assembly on cable.
Solder assembly to braid thru solder holes.
Solder conductor to contact sleeve.

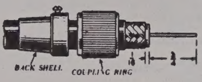


Screw coupling ring on assembly.

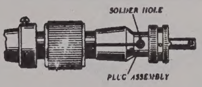
ASSEMBLY OF CABLES TO 83-1SPN PLUG



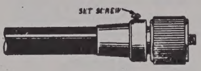
Cut end of cable even.
Remove vinyl jacket 1 1/8"—*don't nick braid.*


BACK SHELL
COUPLING RING
1/16
3/4

Bare 3/4" of center conductor—*don't nick conductor.*
Trim braided shield 1/16" and tin.
Slide back shell and coupling ring on cable.

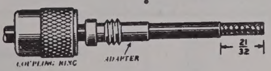

SOLDER HOLE
PLUG ASSEMBLY

Screw the plug assembly on cable.
Solder plug assembly to braid thru solder holes.
Solder conductor to contact sleeve.

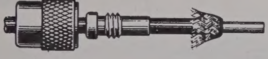


Position coupling ring and back shell.
Tighten set screw.

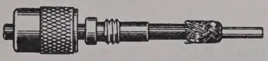
ASSEMBLY OF CABLES TO 83-1SP PLUG USING ADAPTERS 83-168 AND 83-185


COUPLING RING
ADAPTER
21/32

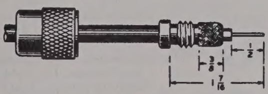
Cut end of cable even.
Remove vinyl jacket 21/32"—*don't nick braid.*
Slide coupling ring and adapter on cable.



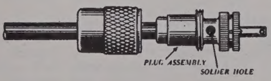
Fan braid slightly and fold back over cable.



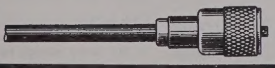
Compress braid around cable.
Position adapter to dimension shown.
Press braid down over body of adapter and trim.



Bare 1/2" of center conductor—*don't nick conductor.*
Pre-tin exposed center conductor.


PLUG ASSEMBLY
SOLDER HOLE

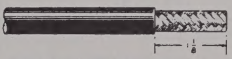
Screw the plug assembly on adapter.
Solder braid to shell thru solder holes.
Solder conductor to contact sleeve.



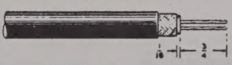
Screw coupling ring on back shell.

ASSEMBLY OF TWINAX TO 83-22SP PLUG

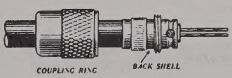
Plugs 83-2SP and 83-21SP are assembled as shown except remove vinyl jacket 1 1/4".



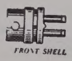
Cut end of cable even.
Remove vinyl jacket 1 1/8"—*don't nick braid.*



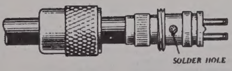
Bare 3/4" of conductors—*don't nick conductors.*
Trim braided shield 1/16" and tin.


COUPLING RING
BACK SHELL

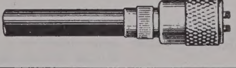
Slide coupling ring on cable.
Screw back shell on cable—see that solder hole lines up with conductor as shown.


FRONT SHELL

Assemble front shell to back shell.
If assembled properly, the solder holes in both front shell and back shell will line up.


SOLDER HOLE

Solder braid to shells thru solder holes.
Solder conductors to contact sleeves.

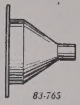


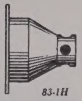
Screw coupling ring on back shell.

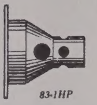
A 7135402

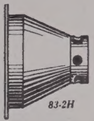
TITLE **INSTRUCTIONS** FIRST MADE FOR **GENERAL USE**

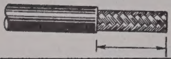
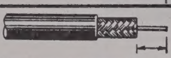
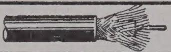
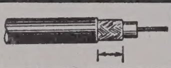
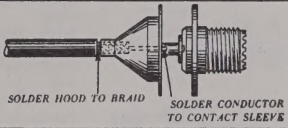
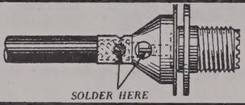
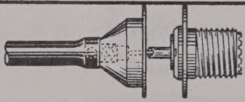
ASSEMBLY OF 83 SERIES, UHF RECEPTACLES USING HOODS


83-765

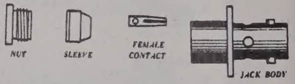

83-1H

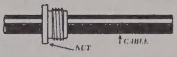

83-1HP


83-2H

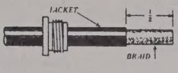
		83-765	83-1H	83-1HP	83-2H
	Cut end of cable even. Remove vinyl jacket. . . . . *Do not nick braid.*	3/4"	5/8"	3/4"	3/4"
	Remove braid and dielectric to expose center conductor. . . . . *Do not nick conductor.*	5/16"	5/16"	5/16"	5/16"
	Fan braided shielding.				
	Smooth out shielding. Trim braid to size. . . . . . Tin braid and wipe clean. Soldering and assembly depends on the hood used, as illustrated.	3/8"	3/16	3/8"	3/16
	Slide hood over braid. Solder conductor to contact. Slide hood flush against receptacle and bolt both to chassis. Solder hood to braid as illustrated. . . . . . Tape this junction if necessary.	Yes	No	No	No
	Slide hood over braid. Bring receptacle flush against hood. Solder hood to braid and conductor to contact sleeve thru solder holes as illustrated. . . . . . . Tape junction if necessary.	No	No	Yes	No
	Slide hood over braid and force under vinyl. Place inner conductor in contact sleeve and solder. Push hood flush against receptacle. Solder hood to braid through solder holes. . . . . Tape junction if necessary.	No	Yes	No	Yes

ASSEMBLY INSTRUCTIONS FOR TYPE BNC CONNECTORS

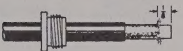




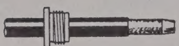
Cut end of cable even.



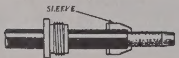
Remove vinyl jacket ½"—*don't nick braid.*



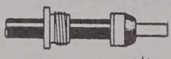
Push braid back, and remove ⅛" of insulation and conductor.



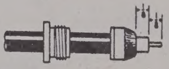
Taper braid.



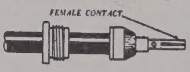
Slide sleeve over tapered braid. Fit inner shoulder of sleeve squarely against end of jacket.



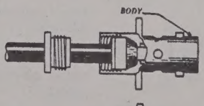
With sleeve in place, comb out braid, fold back smooth as shown, and trim 3/32"



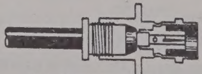
Bare center conductor ⅛"—*don't nick conductor.*



Tin center conductor of cable. Slip female contact in place and solder. Remove excess solder. *Be sure cable dielectric is not heated excessively and swollen so as to prevent dielectric entering body.*



Push into body as far as it will go. Slide nut into body and screw into place, with wrench, until moderately tight. Hold cable and shell rigidly and rotate nut.

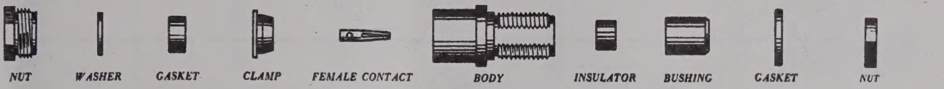

FINAL ASSEMBLY SHOWN IN SECTION

This assembly procedure applies to BNC jacks. The assembly for plugs is the same except for the use of male contacts and a plug body.

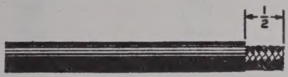
A 7135403

INSTRUCTIONS FIRST MADE FOR GENERAL USE

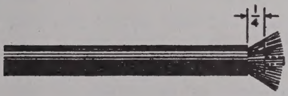
FOR ASSEMBLY OF TYPE N CONNECTORS


NUT
WASHER
GASKET
CLAMP
FEMALE CONTACT
BODY
INSULATOR
BUSHING
GASKET
NUT

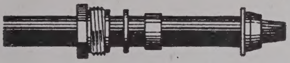
Cut end of cable even.



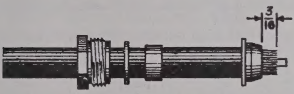
Remove vinyl jacket ½" — *don't nick braid.*



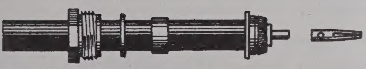
Comb out copper braid as shown. Bare ¼" of center conductor — *don't nick conductor.*



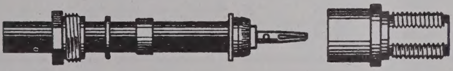
Taper braid as shown. Slide nut, washer and gasket on vinyl jacket. Slide clamp on braid.



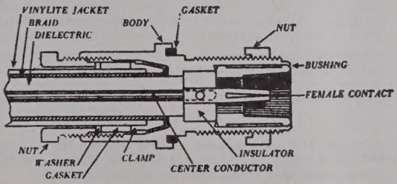
With clamp in place, trim braid as shown.



Fold copper braid back on clamp. Tin center conductor using minimum amount of heat.



Holding contact with pliers, soft solder contact to center conductor. *It is imperative that back end of contact be flush with polyethylene dielectric.* Do not use excess solder. Wipe clean — see that end of cable insulator is clean and free of solder, resin and foreign material.

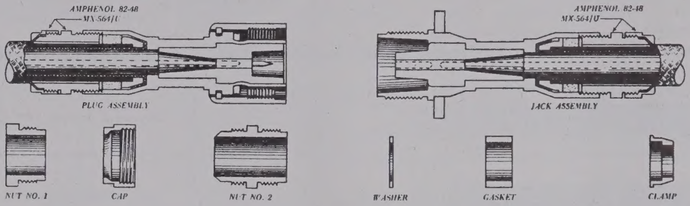

VINYLITE JACKET
BRAID
DIELECTRIC
BODY
GASKET
NUT
BUSHING
FEMALE CONTACT
INSULATOR
CENTER CONDUCTOR
CLAMP
NUT
WASHER
GASKET

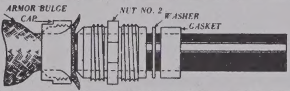
Slide body into place carefully so that center conductor contact enters hole in insulator. Face of cable dielectric must fit flush against insulator. Properly tighten body and nut with wrenches.

A 7135404

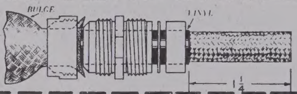
TITLE INSTRUCTIONS FIRST MADE FOR GENERAL USE

INSTRUCTIONS FOR ASSEMBLY OF TYPE HN CONNECTORS

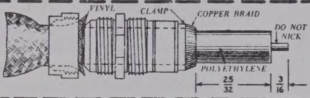

AMPHENOL 82-48
MX-564/U
PLUG ASSEMBLY
AMPHENOL 82-48
MX-564/U
JACK ASSEMBLY
NUT NO. 1
CAP
NUT NO. 2
WASHER
GASKET
CLAMP


ARMOR BULGE
CAP
NUT NO. 2
WASHER
GASKET

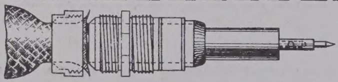
Cut end of RG-10/U cable even. Insert cap over cable armor. Bulge armor braid by pushing armor back on cable 6". Push nut No. 2, washer and gasket over cable jacket.


BULGE
VINYL
1 1/4

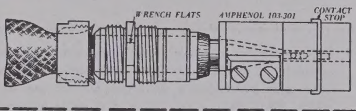
Remove vinyl jacket 1¼"—*don't nick braid.*


VINYL
CLAMP
COPPER BRAID
DO NOT NICK
POLYETHYLENE
25/32
3/16

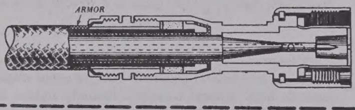
Push clamp over copper braid flush against cable jacket. Cut exposed copper braid so that approximately ¼" remains and fan over clamp. Cut cable dielectric 25/32" from braid—*do not nick center conductor.* Tin exposed conductor.



Solder contact pin, male or female depending on whether a plug or jack is being assembled. Do not overheat dielectric. Do not use excess solder. Wipe clean; see that dielectric is free from solder, resin and foreign material.

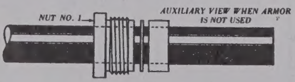

WRENCH FLATS
AMPHENOL 103-301
CONTACT STOP

Taper dielectric with Amphenol 103-301, MX-103/U trimming tool. When tapering dielectric of cable for plug assembly, push contact stop of tool to bottom of slot. Tool will stop cutting when shoulder of contact butts against stop. For jack assembly see that stop is at top of slot. Cable will be properly tapered when end of center contact is flush with end of trimmer body.



Apply small amount of Amphenol 307 Silicone Compound on tapered surface of dielectric. Insert assembly into connector body. Tighten nut No. 1 or nut No. 2 securely with wrench, if cable is armored.

Straighten bulge in armor. Cut armor so that it can be clamped between nut No. 2 and cap. Tighten cap securely on nut No. 2 with wrench.


NUT NO. 1
AUXILIARY VIEW WHEN ARMOR IS NOT USED

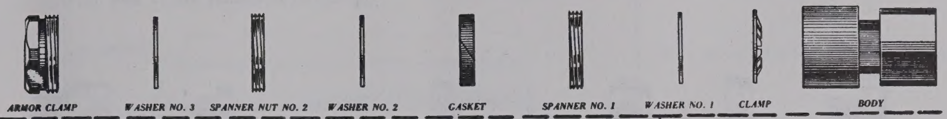
When RG-8/U cable is used, the cap and nut No. 2 (Amphenol 82-48, MX-564/U armor clamp) are not required. Instead, nut No. 1 is used. Cable preparation is the same except for armor.

A 7135405

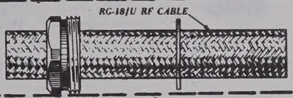
INSTRUCTIONS FIRST MADE FOR GENERAL USE

INSTRUCTIONS FOR ASSEMBLY OF HIGH VOLTAGE CONNECTORS

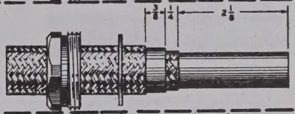
HIGH VOLTAGE CONNECTOR 82-59, UG-154/U TO CABLES RG-17 AND 18/U


ARMOR CLAMP
WASHER NO. 3
SPANNER NUT NO. 2
WASHER NO. 2
GASKET
SPANNER NO. 1
WASHER NO. 1
CLAMP
BODY

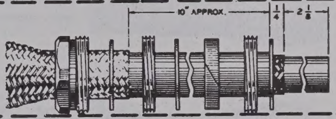
Cut end of cable even. Slide armor clamp and washer No. 3 over armor.


RG-18/U RF CABLE

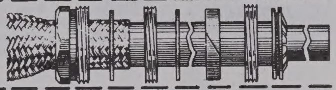
Cut off armor 2¾″ from end—*don't cut vinyl jacket.* Remove vinyl jacket 2⅜″—*don't nick braid.* Remove braid 2⅛″—*don't cut dielectric.*



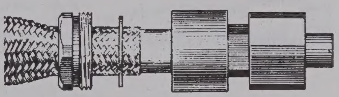
Push armor back approximately 12⅜″ from end. Slide spanner nut No. 2, washer No. 2, gasket and spanner nut No. 1 over vinyl jacket. Carefully slide washer No. 1 over copper braid as shown.


10″ APPROX.
1/4
2 1/8

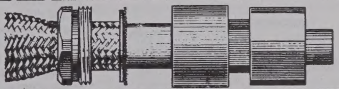
Fan out copper braid radially. Trim any loose or ragged edges. All metal particles must be cleaned off dielectric. Slide clamp over dielectric (prongs toward connector as shown) and press it against copper braid. Apply Amphenol 307 Silicone Compound to clamp surfaces.



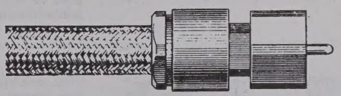
Insert formed end of cable into plug body. With a spanner wrench, screw spanner nut No. 1 very tight against washer No. 1. This locks the copper braid and forces the clamp into the dielectric. It is necessary to exert sufficient pressure to insure clamp is pressed into dielectric and is flattened to provide good contact with braid. Apply a thin film of Amphenol 307 Silicone Compound to the surfaces of the gasket. This provides for better sealing. Slide washer No. 2 against gasket. Screw spanner nut No. 2 tight against washer No. 2. See cross section below for relative position of parts.



Flare out armor braid end ¼″ (radially).

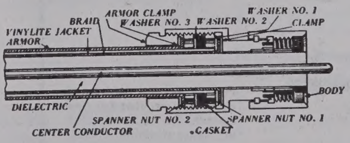


Push armor into body by straightening bulge. Push washer No. 3 against armor. Screw up armor nut tight against washer No. 3. With sharp knife, cut dielectric flush with forward edge of coupling ring. *Do not nick center conductor.* Pry off cut dielectric. Cut off center conductor ½″ from forward edge of coupling ring. File end of center conductor round. Clean off all filings. Apply small amount of Amphenol 307 Silicone Compound to end of dielectric just before mating this plug into an adaptor or receptacle.



NOTE:

When using RG-17/U disregard all instructions pertaining to armor.

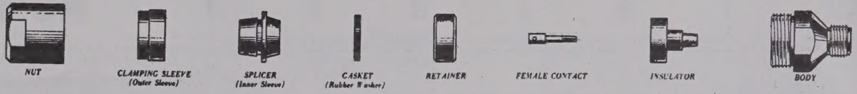

ARMOR CLAMP
WASHER NO. 1
BRAID
WASHER NO. 3
WASHER NO. 2
CLAMP
VINYLITE JACKET
ARMOR
BODY
DIELECTRIC
SPANNER NUT NO. 2
SPANNER NUT NO. 1
CENTER CONDUCTOR
GASKET

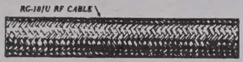
A 7135406

TITLE INSTRUCTIONS FIRST MADE FOR GENERAL USE

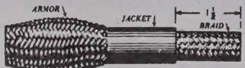
INSTRUCTIONS *FOR ASSEMBLY OF CABLE TO CABLE ADAPTERS*

High Voltage Adapters 82-56, UG-333/U and 82-57, UG-334/U to Cables RG-17 and 18/U

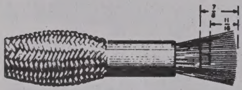

NUT
CLAMPING SLEEVE (Outer Sleeve)
SPLICER (Inner Sleeve)
CASKET (Rubber Washer)
RETAINER
FEMALE CONTACT
INSULATOR
BODY


RG-18/U RF CABLE

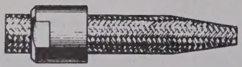
Cut end of cable even.


ARMOR
JACKET
$1\frac{1}{2}$
BRAID

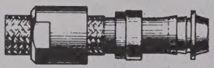
Push armor back out of way. Remove vinyl jacket 1½" — *don't nick braid.*


$\frac{7}{8}$
$\frac{11}{16}$

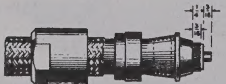
Fan copper braid out as shown. Cut off dielectric ⅞" from end, sharp and even—*don't nick conductor.* Cut off center conductor 11/16" from end



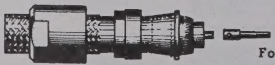
Push armor toward end, and taper end of braid and armor as shown. Slide nut (armor clamp) on over the armor.



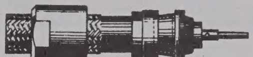
Push armor and nut back. Slide outer sleeve on over the vinyl jacket. Slide inner sleeve over braid and under vinyl jacket until vinyl jacket touches large rim of inner sleeve. If inner sleeve goes on tight, twist sleeve while forcing into position.


$\frac{1}{4}$
$\frac{3}{16}$
$\frac{3}{16}$

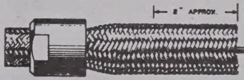
With inner sleeve in place, trim copper braid leaving 3/16" exposed as shown.



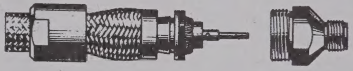
Fold copper braid back over inner sleeve and smooth. Tin center conductor, using minimum amount of heat.



Holding contact with pliers, soft-solder contact to center conductor. Do not use excess solder. Wipe clean. See that end of cable insulation is clean and free of solder, resin, and foreign material. Slip rubber washer over inner sleeve as shown. Slide outer sleeve as close as possible to inner sleeve.



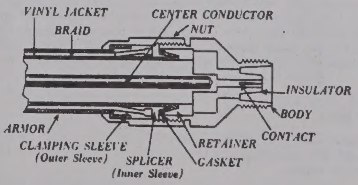
Pull armor up as far as possible. Cut off approximately 2" from end of armor.



Push armor back and place end of armor halfway on the shoulder portion of outer sleeve as shown. Slide nut over outer sleeve. Apply small amount of Amphenol 307 Silicone Compound to cable dielectric. Slide body into place carefully so that center conductor contact enters hole in insulator. Face of cable dielectric must fit flush against insulator. Properly tighten body and nut with wrenches.

NOTE:

When using RG-17/U cable disregard all instructions pertaining to armor.


VINYL JACKET
BRAID
CENTER CONDUCTOR
NUT
INSULATOR
BODY
CONTACT
ARMOR
CLAMPING SLEEVE (Outer Sleeve)
SPLICER (Inner Sleeve)
RETAINER
GASKET

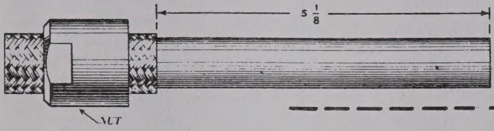
HN plug 82-38, UG-59A/U mates with these adapters.

A 7135407

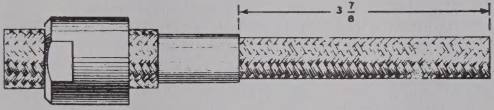
TITLE INSTRUCTIONS FIRST MADE FOR GENERAL USE

INSTRUCTIONS . . . FOR ADAPTER ASSEMBLY OF FLEXIBLE CABLE TO RIGID LINE

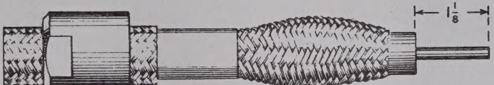
Adapters 144-001 to Cables RG-17/U and RG-18/U



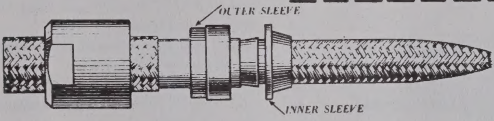
Place nut over armor and remove armor 5⅛".



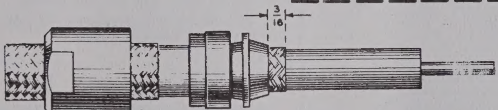
Remove vinyl jacket 3⅞" — *don't nick braid.*



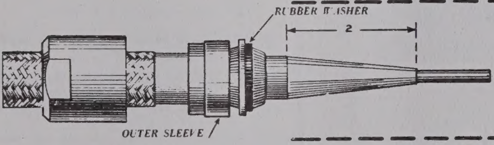
Push back copper braid and bare center conductor 1⅛" and tin.



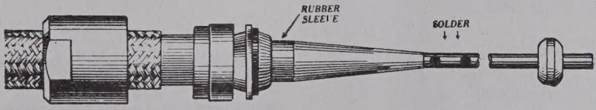
Pull braid down and taper end. Slide outer sleeve on the vinyl jacket. Slide inner sleeve over braid and under vinyl until vinyl jacket touches large rim of inner sleeve.



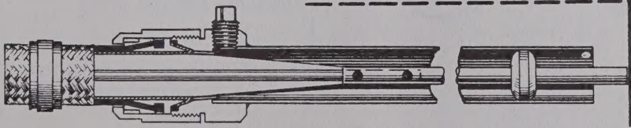
With inner sleeve in place, comb out and trim copper braid leaving 3/16" exposed.



Fold copper braid back over inner sleeve and smooth. Taper dielectric to dimension shown. Slip rubber washer over inner sleeve. Pull up outer sleeve as close as possible to inner sleeve shoulder.



Apply small amount of Amphenol 307 Silicone Compound to inside and outside surfaces of rubber sleeve and slip sleeve over dielectric. Soft-solder center conductor assembly to center conductor as shown. Do not use excess solder. Wipe clean, see that dielectric is clean and free of solder resin and foreign material.



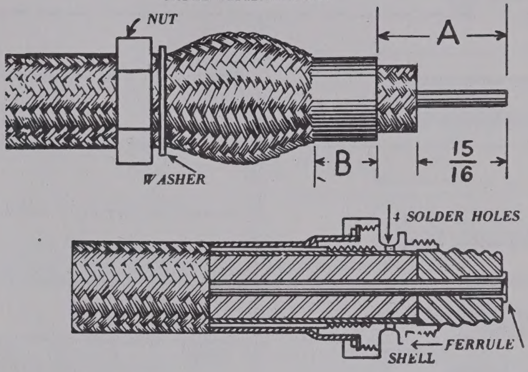
Slide body assembly into place carefully so that sleeve distortion is held to a minimum. Slide nut over outer sleeve. Tighten body and nut with wrenches. Place armor clamp over armor and fasten securely. Omit armor clamp when RG-17/U cable is used.

A 7135408

TITLE INSTRUCTIONS FIRST MADE FOR GENERAL USE

INSTRUCTIONS FOR ASSEMBLY OF AMPHENOL END SEALS AND TERMINATIONS

CABLE TERMINATIONS



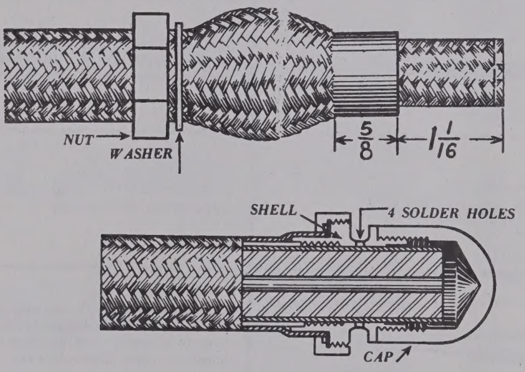
Steps

1. Remove "A" of armor and vinyl jacket.
2. Remove 15/16" of shield and dielectric.
3. Slide nut and washer or clamp on cable.
4. Force armor back exposing "B" vinyl.
5. Lead center conductor into hole in insulator.
6. Screw shell on vinyl jacket.
7. Solder thru solder holes in shell.
8. Solder conductor to ferrule.
9. Slide armor over back of shell forming it to shell and trim off excess.
10. Anchor armor.

DIMENSIONS

	152-101	152-102	152-103
A	1-1/4"	1-1/8"	1-15/16"
B	5/8"	3/4"	5/8"

END SEALS

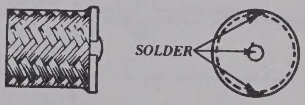


Steps

1. Remove 1-1/16" of armor and vinyl jacket.
2. Slide nut and washer on cable.
3. Force armor back exposing 5/8" vinyl.
4. Screw shell on vinyl jacket.
5. Solder thru solder holes in shell.
6. Slide armor over back of shell forming it to shell and trim excess.
7. Anchor armor with nut and washer.
8. Half fill cap with Amphenol 307 Silicone Compound and screw on shell.

152-204	All steps listed.
152-205	All steps listed plus application of shorting washer.
152-202	Follow steps 1, 4, 5, and 8.
152-203	Follow steps 1, 4, 5, 8, plus application of shorting washer.
152-201	Half fill end seal with Amphenol 307 Silicone Compound and force over cable. Slip clamp over end seal and clamp tight.

SHORTING TYPE END SEALS



For shorting types, expose 1/16" of conductor and solder to washer all around hole.

Solder shield to washer in two places — minimum flow 1/4".

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GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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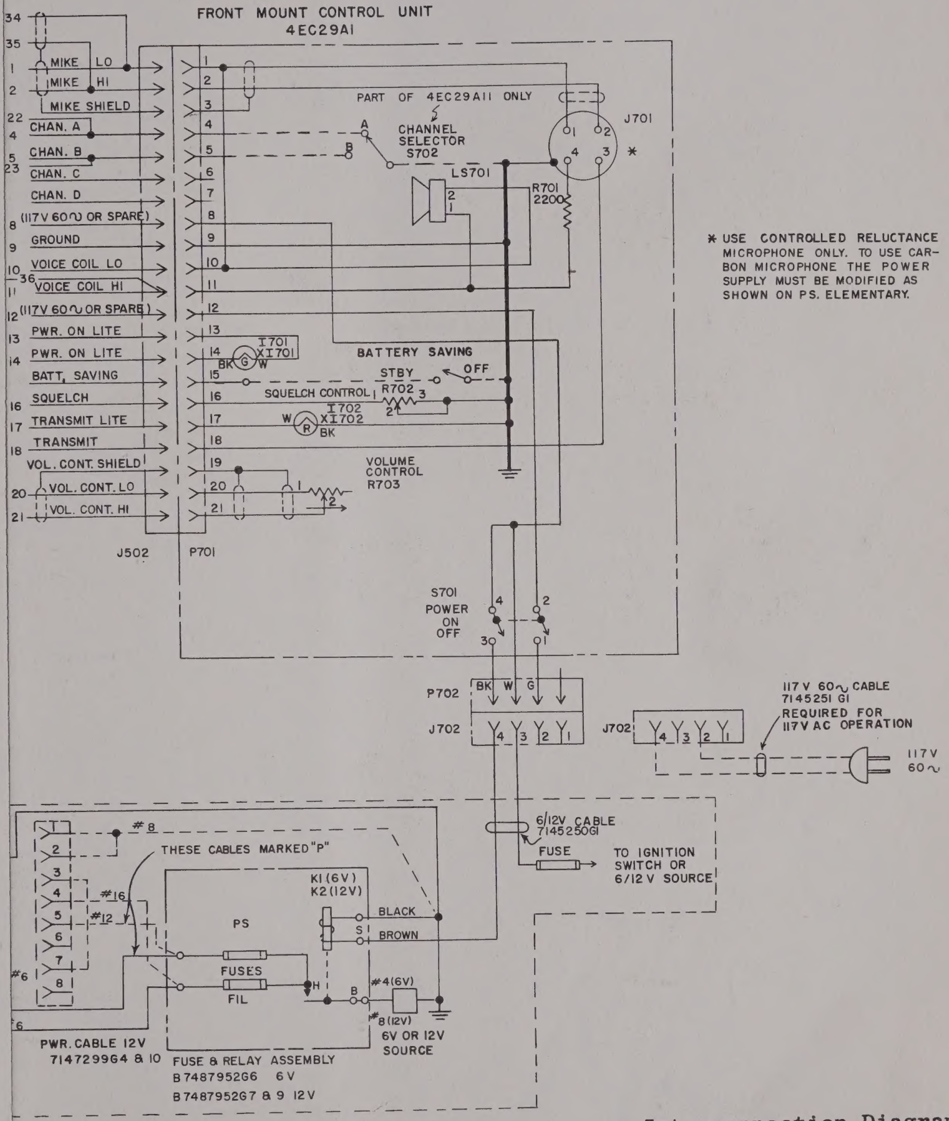

FRONT MOUNT CONTROL UNIT
4EC29A1
34
35
1
2
22
4
5
23
8
9
10
36
11
12
13
14
16
17
18
20
21
MIKE LO
MIKE HI
MIKE SHIELD
CHAN. A
CHAN. B
CHAN. C
CHAN. D
(117V 60∿ OR SPARE)
GROUND
VOICE COIL LO
VOICE COIL HI
(117V 60∿ OR SPARE)
PWR. ON LITE
PWR. ON LITE
BATT. SAVING
SQUELCH
TRANSMIT LITE
TRANSMIT
VOL. CONT. SHIELD
VOL. CONT. LO
VOL. CONT. HI
J502
P701
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
PART OF 4EC29A11 ONLY
A
B
CHANNEL SELECTOR S702
J701
1
2
4
3
*
LS701
2
1
R701
2200
I701
XI701
BK
G
W
BATTERY SAVING
STBY
OFF
SQUELCH CONTROL
R702
1
3
2
I702
XI702
W
R
BK
VOLUME CONTROL R703
1
2
S701
POWER
ON
OFF
4
2
3
1
P702
BK
W
G
J702
4
3
2
1
J702
4
3
2
1
117 V 60∿ CABLE 7145251 G1
REQUIRED FOR 117V AC OPERATION
117V 60∿
6/12V CABLE 7145250G1
FUSE
TO IGNITION SWITCH OR 6/12 V SOURCE
1
2
3
4
5
6
7
8
#8
THESE CABLES MARKED "P"
#16
#12
#6
6
PS
K1 (6V)
K2 (12V)
BLACK
S
BROWN
FUSES
H
FIL
B
#4 (6V)
#8 (12V)
6V OR 12V SOURCE
PWR. CABLE 12V
714729964 & 10
FUSE & RELAY ASSEMBLY
B7487952G6 6V
B7487952G7 & 9 12V

* USE CONTROLLED RELUCTANCE MICROPHONE ONLY. TO USE CARBON MICROPHONE THE POWER SUPPLY MUST BE MODIFIED AS SHOWN ON PS. ELEMENTARY.

Interconnection Diagram

FRONT-MOUNT COMBINATIONS

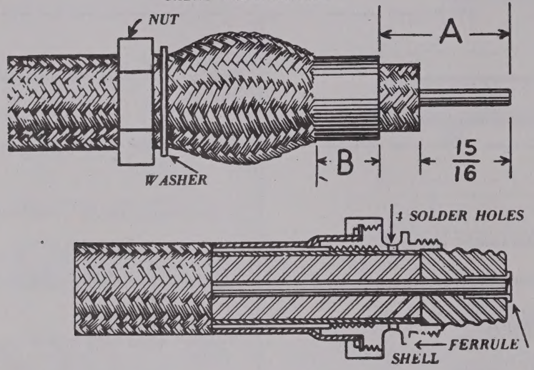
(D-7668778, Rev. 11)

A 7135408

TITLE INSTRUCTIONS FIRST MADE FOR GENERAL USE

INSTRUCTIONS FOR ASSEMBLY OF AMPHENOL END SEALS AND TERMINATIONS

CABLE TERMINATIONS



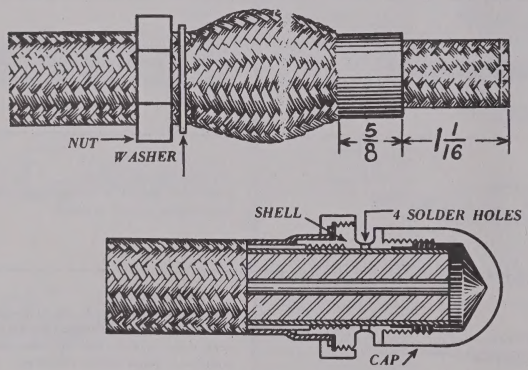
Steps

1. Remove "A" of armor and vinyl jacket.
2. Remove 15/16" of shield and dielectric.
3. Slide nut and washer or clamp on cable.
4. Force armor back exposing "B" vinyl.
5. Lead center conductor into hole in insulator.
6. Screw shell on vinyl jacket.
7. Solder thru solder holes in shell.
8. Solder conductor to ferrule.
9. Slide armor over back of shell forming it to shell and trim off excess.
10. Anchor armor.

DIMENSIONS

	152-101	152-102	152-103
A	1-1/4"	1-1/8"	1-15/16"
B	5/8"	3/4"	5/8"

END SEALS

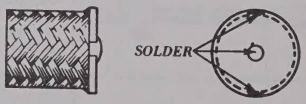


Steps

1. Remove 1-1/16" of armor and vinyl jacket.
2. Slide nut and washer on cable.
3. Force armor back exposing 5/8" vinyl.
4. Screw shell on vinyl jacket.
5. Solder thru solder holes in shell.
6. Slide armor over back of shell forming it to shell and trim excess.
7. Anchor armor with nut and washer.
8. Half fill cap with Amphenol 307 Silicone Compound and screw on shell.

152-204	All steps listed.
152-205	All steps listed plus application of shorting washer.
152-202	Follow steps 1, 4, 5, and 8.
152-203	Follow steps 1, 4, 5, 8, plus application of shorting washer.
152-201	Half fill end seal with Amphenol 307 Silicone Compound and force over cable. Slip clamp over end seal and clamp tight.

SHORTING TYPE END SEALS



For shorting types, expose 1/16" of conductor and solder to washer all around hole.

Solder shield to washer in two places — minimum flow 1/4".

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LYNCHBURG, VIRGINIA

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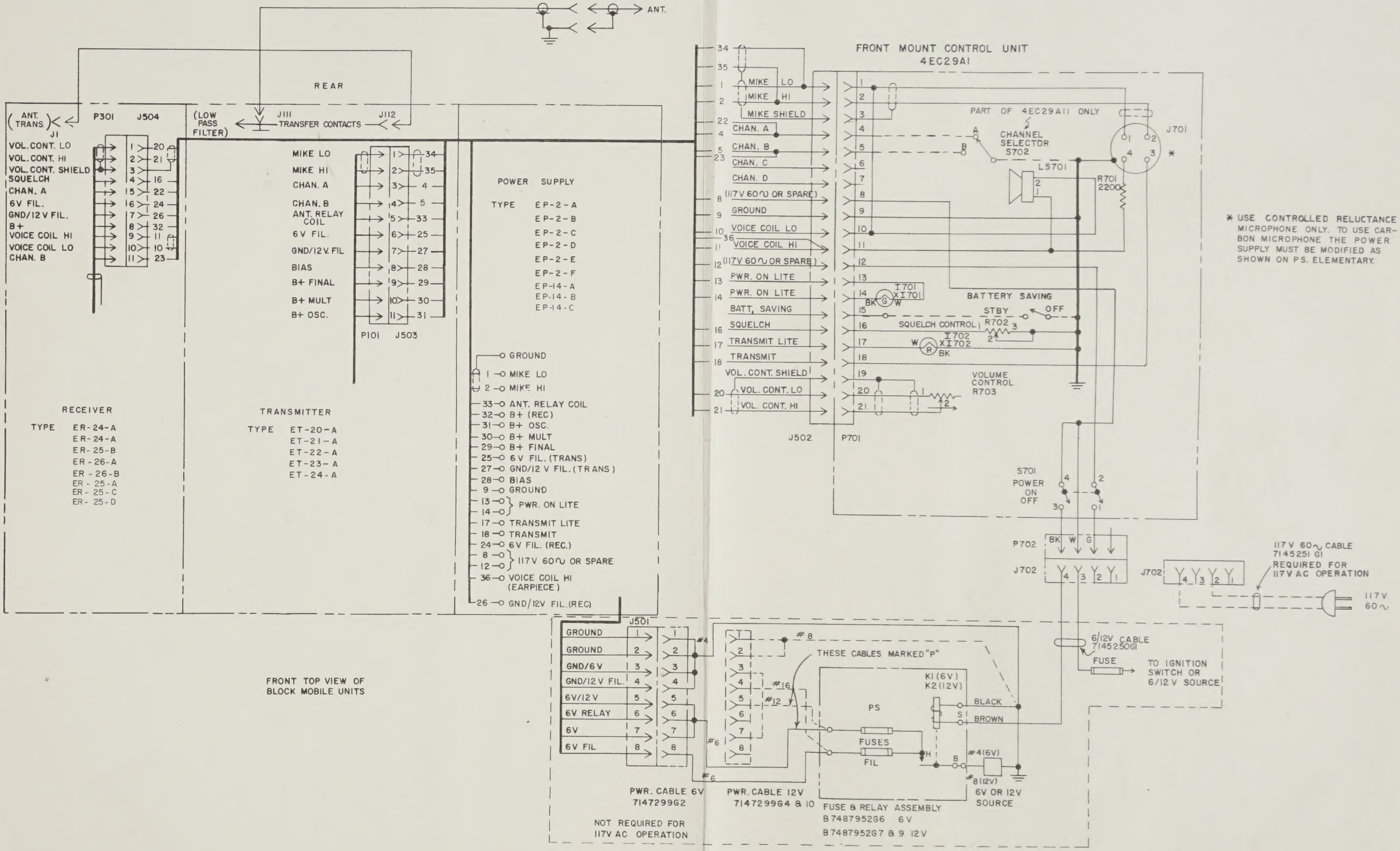
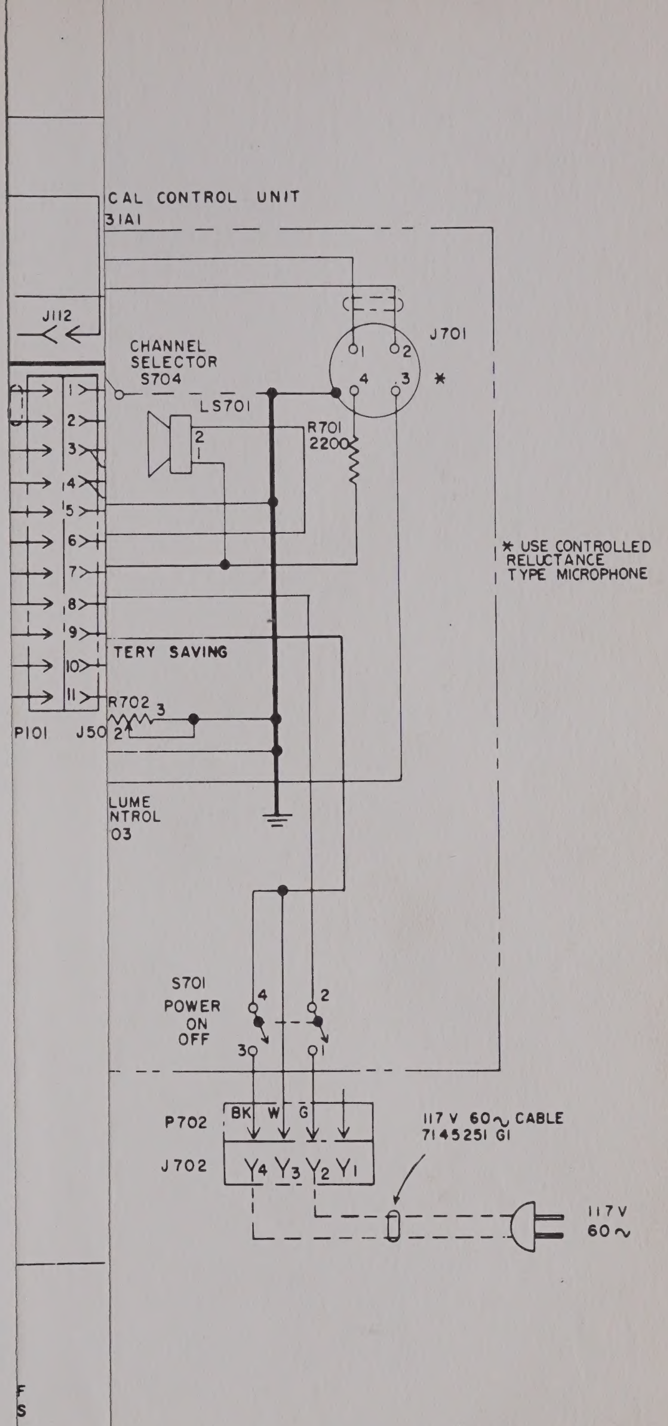

ANT.
REAR
ANT. TRANS.
J1
P301
J504
(LOW PASS FILTER)
J111
TRANSFER CONTACTS
J112
VOL.CONT. LO
VOL.CONT. HI
VOL.CONT. SHIELD
SQUELCH
CHAN. A
6V FIL.
GND/12V FIL.
B+
VOICE COIL HI
VOICE COIL LO
CHAN. B
MIKE LO
MIKE HI
CHAN. A
CHAN. B
ANT. RELAY COIL
6V FIL.
GND/12V. FIL
BIAS
B+ FINAL
B+ MULT
B+ OSC.
P101
J503
POWER SUPPLY
TYPE EP-2-A
EP-2-B
EP-2-C
EP-2-D
EP-2-E
EP-2-F
EP-14-A
EP-14-B
EP-14-C
GROUND
1 MIKE LO
2 MIKE HI
33 ANT. RELAY COIL
32 B+ (REC)
31 B+ OSC.
30 B+ MULT
29 B+ FINAL
25 6V FIL. (TRANS)
27 GND/12 V FIL. (TRANS)
28 BIAS
9 GROUND
13, 14 PWR. ON LITE
17 TRANSMIT LITE
18 TRANSMIT
24 6V FIL. (REC.)
8, 12 117V 60∿ OR SPARE
36 VOICE COIL HI (EARPIECE)
26 GND/12V FIL.(REC)
RECEIVER
TYPE ER-24-A
ER-24-A
ER-25-B
ER-26-A
ER-26-B
ER-25-A
ER-25-C
ER-25-D
TRANSMITTER
TYPE ET-20-A
ET-21-A
ET-22-A
ET-23-A
ET-24-A
FRONT TOP VIEW OF BLOCK MOBILE UNITS
FRONT MOUNT CONTROL UNIT
4EC29A1
MIKE LO
MIKE HI
MIKE SHIELD
CHAN. A
CHAN. B
CHAN. C
CHAN. D
(117V 60∿ OR SPARE)
GROUND
VOICE COIL LO
VOICE COIL HI
(117V 60∿ OR SPARE)
PWR. ON LITE
PWR. ON LITE
BATT. SAVING
SQUELCH
TRANSMIT LITE
TRANSMIT
VOL. CONT. SHIELD
VOL. CONT. LO
VOL. CONT. HI
J502
P701
PART OF 4EC29A11 ONLY
CHANNEL SELECTOR S702
J701
LS701
R701 2200
I701 XI701
BK G W
BATTERY SAVING
STBY OFF
SQUELCH CONTROL R702
I702 XI702
W R BK
VOLUME CONTROL R703
* USE CONTROLLED RELUCTANCE MICROPHONE ONLY. TO USE CARBON MICROPHONE THE POWER SUPPLY MUST BE MODIFIED AS SHOWN ON PS. ELEMENTARY.
S701 POWER ON OFF
P702
BK W G
J702
117 V 60∿ CABLE 7145251 G1 REQUIRED FOR 117V AC OPERATION
117V 60∿
6/12V CABLE 7145250G1
FUSE
TO IGNITION SWITCH OR 6/12 V SOURCE
J501
GROUND
GROUND
GND/6V
GND/12 V FIL.
6V/12 V
6V RELAY
6V
6V FIL
#4
#8
#16
#12
#6
THESE CABLES MARKED "P"
K1 (6V) K2 (12V)
PS
BLACK
BROWN
FUSES
FIL
H
B
S
#4 (6V)
#8 (12V)
6V OR 12V SOURCE
PWR. CABLE 6V 7147299G2
PWR. CABLE 12V 7147299G4 & 10
FUSE & RELAY ASSEMBLY B7487952G6 6V B7487952G7 & 9 12V
NOT REQUIRED FOR 117V AC OPERATION

Interconnection Diagram

FRONT-MOUNT COMBINATIONS

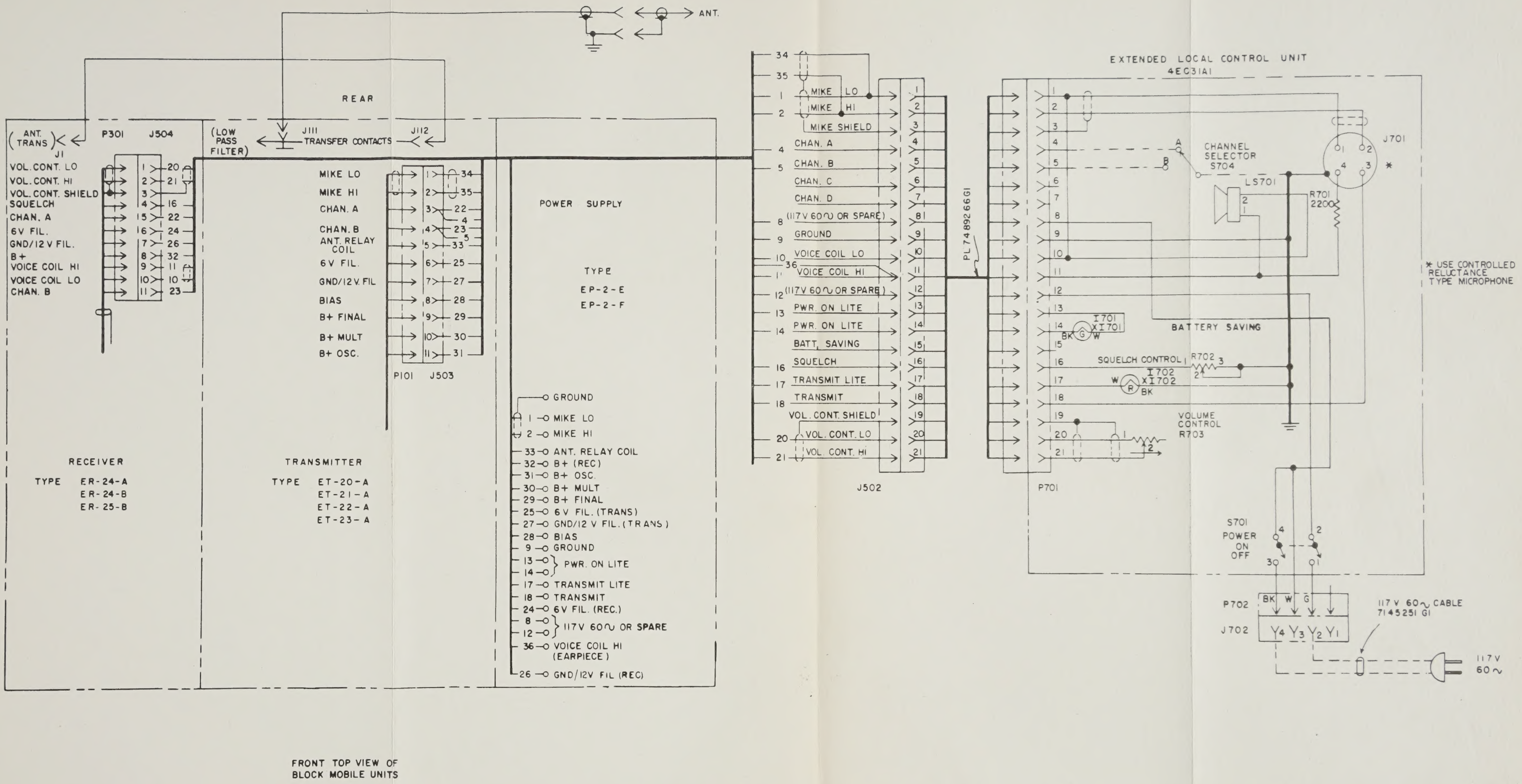
(D-7668778, Rev. 11)


CAL CONTROL UNIT
31A1
J112
CHANNEL
SELECTOR
S704
J701
1
2
4
3
*
LS701
2
1
R701
2200
1
2
3
4
5
6
7
8
9
10
11
TERY SAVING
R702
3
2
P101
J50
LUME
NTROL
03
* USE CONTROLLED
RELUCTANCE
TYPE MICROPHONE
S701
POWER
ON
OFF
4
2
3
1
P702
BK
W
G
J702
Y4 Y3 Y2 Y1
117 V 60~ CABLE
7145251 G1
117 V
60~
F
S

Interconnection Diagram

AC MOBILE COMBINATIONS USING
EXTENDED-LOCAL CONTROL

(D-7669509, Rev. 0)


ANT.
REAR
ANT. TRANS
J1
P301
J504
(LOW PASS FILTER)
J111
TRANSFER CONTACTS
J112
VOL. CONT. LO
VOL. CONT. HI
VOL. CONT. SHIELD
SQUELCH
CHAN. A
6V FIL.
GND/12 V FIL.
B+
VOICE COIL HI
VOICE COIL LO
CHAN. B
MIKE LO
MIKE HI
CHAN. A
CHAN. B
ANT. RELAY COIL
6V FIL.
GND/12 V. FIL
BIAS
B+ FINAL
B+ MULT
B+ OSC.
P101
J503
POWER SUPPLY
TYPE
EP-2-E
EP-2-F
GROUND
1 MIKE LO
2 MIKE HI
33 ANT. RELAY COIL
32 B+ (REC)
31 B+ OSC.
30 B+ MULT
29 B+ FINAL
25 6 V FIL. (TRANS)
27 GND/12 V FIL. (TRANS)
28 BIAS
9 GROUND
13, 14 PWR. ON LITE
17 TRANSMIT LITE
18 TRANSMIT
24 6V FIL. (REC.)
8, 12 117V 60∼ OR SPARE
36 VOICE COIL HI (EARPIECE)
26 GND/12V FIL (REC)
RECEIVER
TYPE ER-24-A
ER-24-B
ER-25-B
TRANSMITTER
TYPE ET-20-A
ET-21-A
ET-22-A
ET-23-A
FRONT TOP VIEW OF BLOCK MOBILE UNITS
MIKE LO
MIKE HI
MIKE SHIELD
CHAN. A
CHAN. B
CHAN. C
CHAN. D
(117V 60∼ OR SPARE)
GROUND
VOICE COIL LO
VOICE COIL HI
(117V 60∼ OR SPARE)
PWR. ON LITE
PWR. ON LITE
BATT. SAVING
SQUELCH
TRANSMIT LITE
TRANSMIT
VOL. CONT. SHIELD
VOL. CONT. LO
VOL. CONT. HI
J502
PL 74892 66G1
EXTENDED LOCAL CONTROL UNIT
4EC31A1
CHANNEL SELECTOR
S704
J701
LS701
R701
2200
I701
XI701
BK G W
BATTERY SAVING
SQUELCH CONTROL
R702
I702
XI702
W R BK
VOLUME CONTROL
R703
P701
* USE CONTROLLED RELUCTANCE TYPE MICROPHONE
S701
POWER ON OFF
P702
J702
BK W G
Y4 Y3 Y2 Y1
117 V 60∼ CABLE 7145251 G1
117 V 60∼

Interconnection Diagram

AC MOBILE COMBINATIONS USING
EXTENDED-LOCAL CONTROL

(D-7669509, Rev. 0)

PRODUCTION CHANGE SHEET
FOR
TRANSMITTER MODELS 4ET20A1 & 11, REV. R
TRANSMITTER MODELS 4ET20A2 & 12, REV. T

Changes listed below are identified by the letter appearing in the REV. pad.

REV. A (Models 4ET20A2 and 12 only)

Part Changed	Was	Changed To
C135	Added.	Ceramic, 4.0 mmfd ± 0.5 mmfd, 500 v d-c w. P-7770468-P4.
L105	Coil: 3.4 turns at 8 turns per inch 0.637" ID of B11B10A5, 0.060" dia. A-7145857-P1.	Coil: 1-3/4 turns at 16 turns per inch 0.625 ID of Formex, B22F1, 0.641" dia., A-7145857-P1.
L113	Loop: made of B11B10A5, 0.080" dia tinned copper wire. A-7145622-P1.	Loop: made of B11B10A5, 0.080" dia tinned copper wire changing length and configuration of loop. A-7145622-P1.
L118	Coil: 1-1/2 turns at 8 turns per inch, 0.687 ID of B22F1 #14 Awg. A-7145858-P1.	Coil: 2-1/2 turns at 8 turns per inch, 0.625 ID of B22F1 #14 AWG. A-7145858-P1.
R102	Added.	Composition, 470 ohms ± 10%, 1/2 w. C-3R77-P471K.
R116	Composition, 0.10 megohm ± 10%, 1/2 w. C-3R77-P104K.	Replaced by R117.

Part Changed	Was	Changed To
R117	Added in place of R116.	Composition, 27,000 ohms ± 10%, 1/2 w. C-3R77-P273K.
R185	Composition, 0.18 megohm ± 10%,1/2 w. C-3R77-P184K.	Replaced by R188.
R188	Added in place of R185.	Composition, .10 megohm ± 10%, 1/2 w. C-3R77-P104K.
R202	Added.	Composition, 470 ohms ± 10%, 1/2 w. C-3R77-P471K.

Text Change

EBI-41059 - Page 4 - 1st sentence, 1st paragraph under multipliers - change R116 reference to R117.

Schematic Change

C135 - Add between XV106-5 and ground.

R102 - Add in series with XV101-1 (grid) between junction R101-C101 and XV101-1.

R116 - Delete symbol reference and value.

R117 - Add reference and value in place of former R116.

R185 - Delete symbol reference and value.

R188 - Add symbol reference and value in place of former R185.

R202 - Add in series with XV201-1 (grid) between junction R201, C201, and XV201-1.

REV. B (Models 4ET20A2 and 12 only)

Part Changed	Was	Changed to
C128	Added.	Ceramic, temp compensating tube type; 4.0 mmfd ± 10%, 500 v d-c w. P-7770468-P4.
	Added to 4ET20A12	Ceramic, high K disk, 0.0015 mfd +100% -0%, 500 v d-c w. C7774750-P5.

Part Changed	Was	Changed To
L103	RF Choke: inductance 50 uh ± 10%, max current 50 ma, resistance 4.0 ohms. National Type R-33. G-E Part No. K-7127925-P3.	Replaced by R102.
L203	RF Choke: inductance 50 uh ± 10%, max current 50 ma resistance 4.0 ohms. National Type R-33. (Two Freq. use only)	Replaced by R202.
R102	Wired between R101, XY101-4 junction and XV101-1.	Replaces L103.
R202	Wired between R201, XY101-2 junction and XV201-1.	Replaces L203.

Text Change

None.

Schematic Change

C128 - Add symbol, reference and value from XV104-6 to XV104-C (ground).

C205 - Add symbol, reference and value from XV201-6 to XV201-G3 (ground).

L103 - Remove symbol and reference and replace by symbol, reference and value of R102.

L203 - Remove symbol and reference and replace by symbol, reference and value of R202.

R102 - Replace by direct short between R101, XY101-4 junction and XV101-1 and remove reference.

R202 - Replace by direct short between R201, XY201-2 junction and XV201-1.

REV. C (Models 4ET20A2 and 12 only)

REV. A (Models 4ET20A1 and 11 only)

Part Changed	Was	Changed To
C141	Added.	Ceramic high K disk, 0.0015 mfd +100%, -0%, 500 v d-c w. C-777450-P5.

Text Change

None.

Schematic Change

C141 - Add symbol, reference and value from junction of R190 and R144 to ground.

REV. B (Models 4ET20A1 and 11 only)

REV. D (Models 4ET20A2 and 12 only)

Part Changed	Was	Changed To
L101	RF Choke: inductance 50 uh ± 10%, max current 50 ma, resistance 4.0 ohms. National Type R-33. G-E Dwg. K-7127925-P3.	Replaced by L108.
L108	Added in place of L101.	RF Choke: inductance 39 uh ± 10%, Jeffers Cat. #10203-40. G-E Dwg. B-7488079-P50.

Text Changes

Change references from L101 to L108.

Elementary Diagram Changes

Change L101 to L108.

REV. C (Models 4ET20A1 and 11 only)

REV. E (Models 4ET20A2 and 12 only)

Part Changed	Was	Changed To
R188	Resistor: composition, 0.10 megohm ± 10%, 1/2 w. G-E Dwg. C-3R77-P104K.	Replaced by R191
R191	Added in place of R188.	Resistor: composition, 68,000 ohms ± 10%, 1/2 w. G-E Dwg. C-3R77-P683K.

Elementary Diagram Change

R188 (100K) was changed to R191 (68K).

Text Change

None.

REV. D (Models 4ET20A1 and 11 only)

REV. F (Models 4ET20A2 and 12 only)

Part Changed	Was	Changed To
C153	Capacitor: variable air, 2.53 to 12.78 mmfd, 1250 v d-c peak. Johnson Cat. #160-170-43.	Replaced by C167.
C167	Added in place of C153.	Capacitor: variable, air, 3.2 to 12 mmfd, 1400 v d-c peak. Teleradio Cat. #T-9476.
L114	Coil: 2 turns at 11 turns per inch 0.687" ID, of B22F1, #14 AWG, 0.064" dia. G-E Dwg. and Part No. A-7144943-P1.	Replaced by L116.
L116	Added in place of L114.	Coil: 1 turn at 11 turns per inch. 0.687" ID of 0.064" dia, #14 AWG. B22F1. G-E Dwg. and Part No. A-7144943-P2.

Text Changes

References to C153 were changed to C167.

Elementary Diagram Changes

"C153, 2.53-12.78" was changed to "C167, 3.2-12", and "L115" was changed to "L116".

REV. E (Models 4ET20A1 and 11 only)

REV. G (Models 4ET20A2 and 12 only)

Part Changed	Was	Changed To
C102	Capacitor: ceramic, temperature compensating tubular; 47 mmfd ± 10%, 500 v d-c w. G-E Part No. P-7770468-P17.	Replaced by C106
C106	Added in place of C102	Capacitor: ceramic temperature compensating disk; 100 mmfd ± 10%, 500 v d-c w. G-E Part No. C-7774846-P21
C202	Capacitor: ceramic, temperature compensating tubular; 47 mmfd ± 10%, 500 v d-c w. G-E Part No. P-7770468-P17.	Replaced by C206
C206	Added in place of C202	Capacitor: ceramic, temperature compensating disk; 100 mmfd ± 10%, 500 v d-c w. G-E Part No. C-7774846-P21.

Text Changes

C102 was changed to C106.
C202 was changed to C206.

Elementary Diagram Changes

C102, #47 was changed to C106, #100
C202, #47 was changed to C206, #100

REV. F (Models 4ET20A1 and 11 only)

REV. H (Models 4ET20A2 and 12 only)

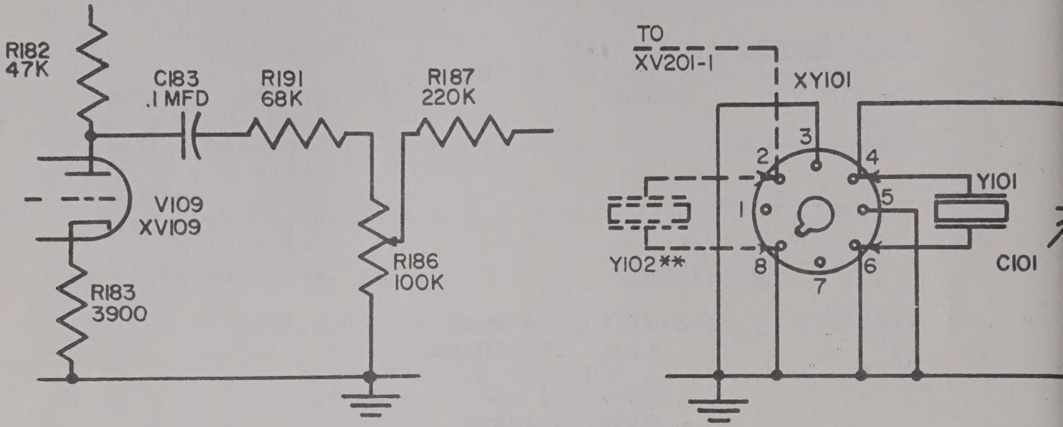
Part Changed	Was	Changed To
C188 thru C190	Added.	Capacitor, silver mica: CM15 case, 180 mmfd ± 10%, 500 v d-c w. Electro Motive Mfg. Type CM-15. G-E Part No. P-3R122-P21.
R191	Resistor, composition: 68,000 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P683K	Deleted.
R193 thru R195	Added	Resistor, composition; 27,000 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P273K.
XY101	Crystal socket and ring: mica-filled phenolic, octal. Cinch Cat. #9865. G-E Part No. A-7140823-P2.	Replaced by XY102.
XY102	Added in place of XY101.	Crystal socket and ring: octal, mica-filled yellow and black phenolic with 2 diametrically opposed keyways. Similar to Cinch Cat. #51E16871. G-E Part No. A-7147225-P1.

Text and Service Outline Changes

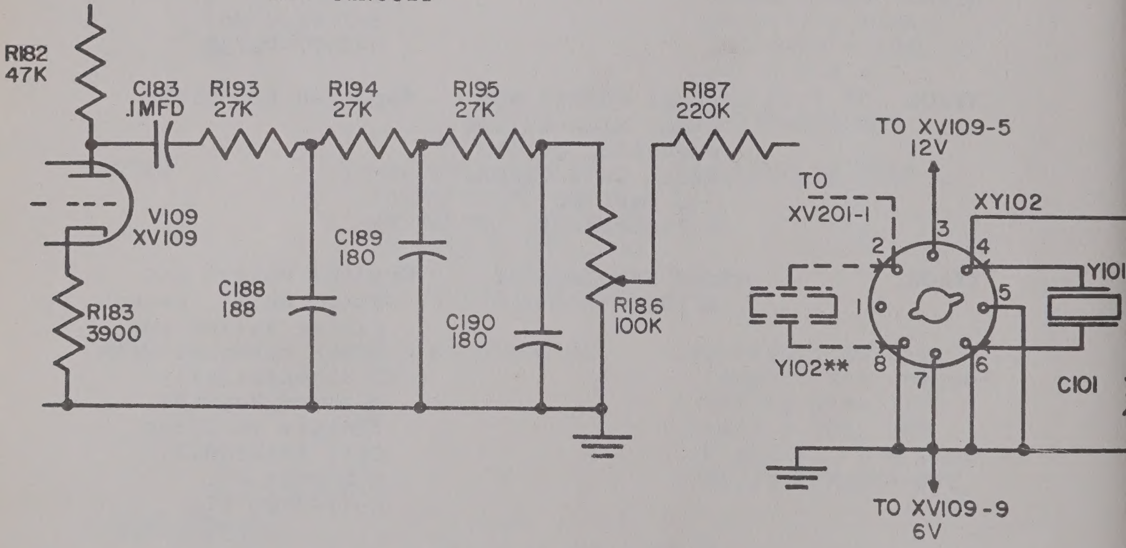
XY101 was changed to XY102.

Elementary Diagram Changes

OLD CIRCUIT:


R182
47K
C183
.1 MFD
R191
68K
R187
220K
V109
XV109
R186
100K
R183
3900
TO
XV201-1
XY101
3
2
4
Y101
1
5
Y102**
8
7
6
C101

NEW CIRCUIT:


R182
47K
C183
.1MFD
R193
27K
R194
27K
R195
27K
R187
220K
TO XV109-5
12V
V109
XV109
C189
180
TO
XV201-1
XY102
C188
188
3
2
4
Y101
R183
3900
1
5
C190
180
R186
100K
Y102**
8
7
6
C101
TO XV109-9
6V

REV. G (Models 4ET20A1 and 11 only)

Part Changed	Was	Changed To
R105	Added.	Resistor, composition; 5600 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P562K.

Elementary Diagram Changes

R105 (5.6 K ohms) was added in parallel with oscillator plate choke L108.

REV. H (Models 4ET20A1 & 11 only)

REV. J (Models 4ET20A2 & 12 only)

Purpose of Change

The construction of the Power Amplifier housing was changed to provide improved ventilation for the PA tube.

Parts List, Elementary Diagram and Text Changes

None.

REV. J (Models 4ET20A1 & 11 only)

REV. K (Models 4ET20A2 & 12 only)

Part Changed	Was	Changed To
K101	Relay: 5 to 7.5 v d-c nominal coil, pickup less than 4.5 v d-c at 25C, dropout 2.25 v d-c at 85 C, resistance 20 ohms 8% at 25 C, contacts 1 form B, 1 form C, contact pressure 30 grams min.	Replaced by K102.

Part Changed	Was	Changed To
K102	Added in place of K101.	Relay: nominal coil rating 4 to 7 v d-c, pickup 3.5 v d-c or less at 25 C, dropout 2 v d-c or less at 25 C, resistance 20-ohms 8% at 25C, 1 form B, 1 form C contact, 30-grams min. pressure.

Text Change

References to K101 changed to read K102.

Elementary Diagram Change

References to K101 changed to read K102.

Service Outline Diagram Change

References to K101 changed to read K102.

REV. K (Models 4ET20A1 and 11 only)

REV. L (Models 4ET20A2 and 12 only)

Purpose of Change

To permit use in Direct Dispatch systems.

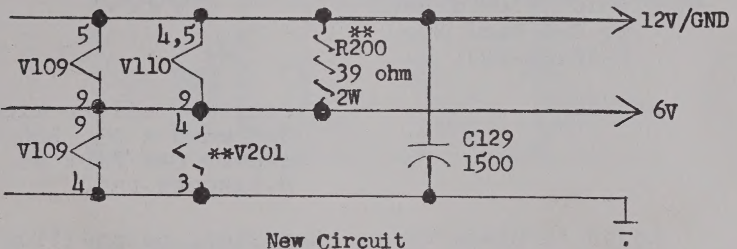
Part Changed	Was	Changed To
C112-B	Capacitor, electrolytic: polarized, twist-prong base, 10-mfd section +50% -10%, 400 v d-c w. G-E Part No. P-7770994-P19.	10-mfd section of C112 unused.

Part Changed	Was	Changed To
C129	Capacitor, ceramic Hi-K disk: 0.0015 mfd +100% -0%, 500 v d-c w. G-E Part No. C-7774750-P5.	Deleted.
R168	Resistor, composition 10,000 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P103K.	Deleted.

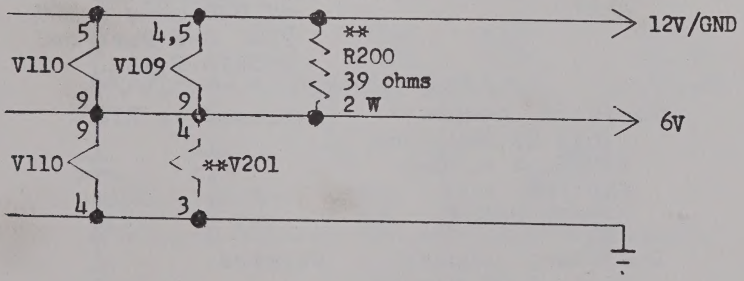
Elementary Diagram Changes

C112-B and C129 were deleted. R168 was replaced by a direct connection to B+ OSC voltage (P101-11). On audio amplifier tube V110, pin 1 and pin 6 were interchanged, pin 2 and pin 7 were interchanged, and pin 3 and pin 8 were interchanged. The audio B-plus input was moved from the 300-volt supply (MULT B+) to the 200-volt supply (OSC B+). The filament circuit was changed as follows:

Old Circuit


12V/GND
5
V109
9
4,5
V110
9
**
R200
39 ohm
2W
6V
9
V109
4
4
**V201
3
C129
1500

New Circuit


12V/GND
5
V110
9
4,5
V109
9
**
R200
39 ohms
2 W
6V
9
V110
4
4
**V201
3

Service Outline Changes

Socket XV110 was rotated 180°. The following voltage and resistance readings were changed:

At XV110-8, 1 V was changed to 3.6 V.
At XV110-6, 42 V was changed to 85 V.
At XV110-3, 3.6 V was changed to 1 V.
At XV110-1, 85 V was changed to 42 V.

At XV110-3, 2200 ohms was changed to 470 ohms.
At XV110-8, 470 ohms was changed to 2200 ohms.

REV. L (Models 4ET20A1 and 11 only)

REV. M (Models 4ET20A2 and 12 only)

Purpose of Change

To decrease power input to PA driver and to increase available audio output voltage from modulation limiter.

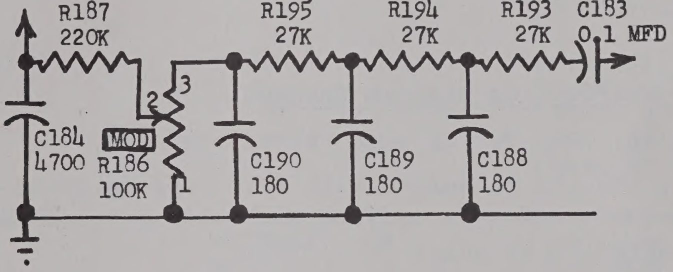
Part Changed	Was	Changed To
C188 thru C190	Capacitor, silver mica: 180 mmfd ± 10%, 500 v d-c w. G-E Part No. P-3R122-P21.	Deleted.
C191 thru C193	Added.	Capacitor, silver mica: 330 mmfd ± 5%, 500 v d-c w. G-E Part No. B-7489162-P39.
R136	Added in place of R137.	Resistor, composition: 47,000 ohms ± 10%, 2 w. G-E Part No. C-3R79-P473K.
R137	Resistor, composition: 22,000 ohms ± 10%, 2 w. G-E Part No. C-3R79-P223K.	Replaced by R136.
R187	Resistor, composition: 0.22 megohm ± 10%, 1/2 w. G-E Part No. C-3R77-P224K.	Deleted.

Part Changed	Was	Changed To
R193 thru R195	Resistor, composition: 27,000 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P273K.	Deleted.
R196	Added.	Resistor, composition: 0.18 megohm ± 10%, 1/2 w. G-E Part No. C-3R77-P184K.
R197 thru R199	Added.	Resistor, composition: 15,000 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P153K.

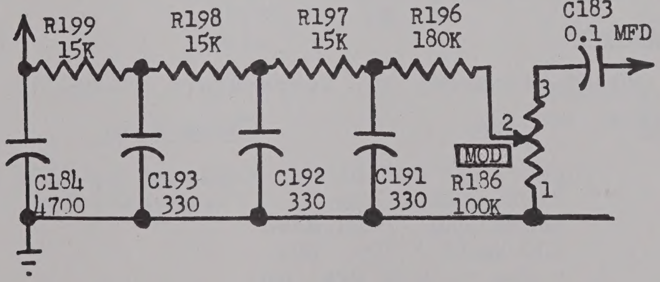
Elementary Diagram Changes

Resistor R137 (22K, 2W), was changed to R136 (47K, 2W). The post-limiter filter was changed as follows:

Old Circuit:


R187
220K
R195
27K
R194
27K
R193
27K
C183
0.1 MFD
2
3
1
C184
4700
MOD
R186
100K
C190
180
C189
180
C188
180

New Circuit:


R199
15K
R198
15K
R197
15K
R196
180K
C183
0.1 MFD
3
2
1
MOD
R186
100K
C184
4700
C193
330
C192
330
C191
330

REV. M (Models 4ET20A1 and 11 only)

REV. N (Models 4ET20A2 and 12 only)

Purpose of Change

To provide more effective filtering for heater of crystal oven.

Part Changed	Was	Changed To
R136	Resistor; composition, 47,000 ohms ± 10%, 2 w. G-E Part No. C-3R79-P473K.	Deleted.
R137	Added.	Resistor; composition, 22,000 ohms ± 10%, 2 w. G-E Part No. C-3R79-P223K.
L127	Added.	R.F. Choke; inductance 100 uh ± 10%. Jeffers Cat. No. 10404-34. G-E Part No. B-7488079-P72.

Text Change

None.

Elementary and Outline Diagram Changes

Changed "R136, 47K, 2w" to read "R137, 22K, 2w".

Added L127, 100 uh, in series with 12V. lead to XY102-3.

REV. N (Models 4ET20A1, 11 only)

REV. P (Models 4ET20A2, 12 only)

Purpose of Change

To improve .0005% frequency vs. temperature stability.

Part Changed	Was	Changed To
C106 and C206	Capacitor: ceramic disk, temp. compensating, insulated 100 mmfd ± 10%, 500 v d-c w. G-E Dwg. No. C-7774846-P21.	Replaced by C194 and C209 respectively.

Part Changed	Was	Changed To
C194 and C209	Capacitor: ceramic, temp. compensating, 100 mmfd ± 10%, 500 v d-c w. G-E Dwg. No. C-7473485-P30.	Replaces C106 and C206 respectively.

Elementary Diagram Changes

Changed delineation of C106, 100 mmfd to read C194, 100 mmfd.
Changed delineation of C206, 100 mmfd to read C209, 100 mmfd.

REV. P (Models 4ET20A1, 11 only)
REV. Q (Models 4ET20A2, 12 only)

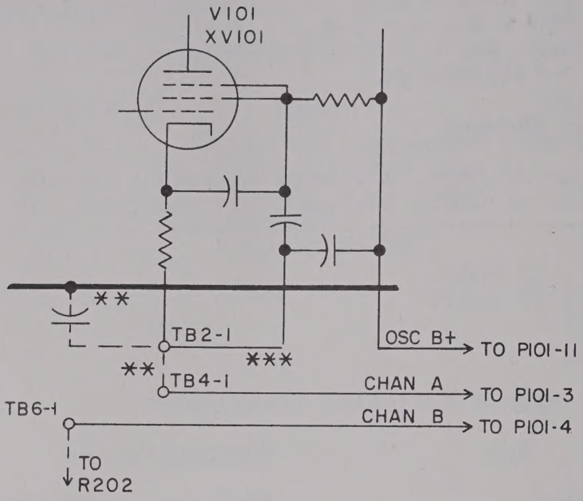
Purpose of Change

To decouple power supply switching transients.

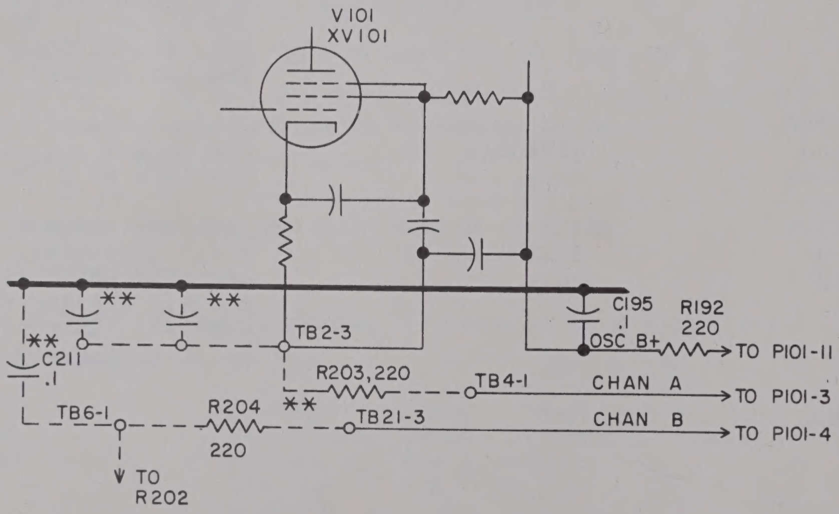
Part Changed	Was	Changed To
R192	Added.	Resistor; composition, 220 ohms ± 10%, 1/2 w. G-E Part No.C-3R77-P221K.
C195	Added.	Capacitor; ceramic, Hi-K disk, 0.1 mfd +80% -25%, 500 v d-c w. Sprague Cat. No. 36C190A. G-E Dwg. No.B-7488160-P3.
R203 and R204	Added to Models 4ET20A11, 12 only.	Resistor; composition, 220 ohms ± 10%, 1/2 w. G-E Part No.C-3R77-P221K.
C210 and C211	Added to Models 4ET20A11, 12 only.	Capacitor; ceramic, Hi-K disk, insulated, 0.1 mfd +80% -30%, 50 v d-c w. Sprague Cat. #36C172. G-E Dwg. No. A-7161189-P2.

Elementary Diagram Changes

Was:


V101
XV101
**
TB2-1
***
**
TB4-1
OSC B+
TO P101-11
CHAN A
TO P101-3
TB6-1
CHAN B
TO P101-4
TO
R202

Changed To:


V101
XV101
**
**
C195
.1
R192
220
**
C211
.1
TB2-3
OSC B+
TO P101-11
R203,220
TB4-1
CHAN A
TO P101-3
**
R204
220
TB21-3
CHAN B
TO P101-4
TB6-1
TO
R202

REV. R (Models 4ET20A2, 12 only)

Purpose of Change

To allow transmitter to withstand operation with an open load circuit.

Part Changed	Was	Changed To
C161 C163 C164	Capacitor; ceramic standoff style, insulated, 22 mmfd ± 5%, 500 v d-c w. Erie Type 323-04. G-E Dwg. No. K-7130608-P3.	Replaced by C196, C198 and C197 respectively
C196 C197 C198	Capacitor; part of mechanical assembly.	Replaces C161, C164 and C163 respectively
C162 and C165	Capacitor: ceramic temp compensating, tubular, 7.0 mmfd ± 0.5 mmfd, 500 v d-c w. G-E Dwg. No. P-7770468-P7.	Replaced by C207 and C208 respectively.
C207 and C208	Capacitor; ceramic, temp. compensating, tubular, 7.0 mmfd ± 0.5% mmfd, 500 v d-c w. G-E Dwg. No. P-7770468-P7.	Replaces C162 and C165 respectively.
C166	Capacitor; ceramic standoff style, insulated, 7 mmfd ± 5%, 500 v d-c w. Erie Type 323-04, G-E Dwg. No. K-7130608-P2.	Deleted.
L124	Coil; 2 turns at 11-1/2 turns per inch, 0.25-inch ID, of B11B10A5, 0.064-inch dia. G-E Dwg. No. A-7145060-P1.	Replaced by L204.
L204	Coil; 2 turns, right-hand wound. G-E Dwg. No. A-4031598-P1.	Replaces L124.

REV. R (Cont'd)

Part Changed	Was	Changed To
L125	Coil; 3 turns at 8 turns per inch, right-hand wound 0.38 inches ID, of B11B10A5, 0.064 inch dia. G-E Dwg. No. A-7145062-P1.	Replaced by L205.
L205	Coil; 3 turns, right-hand wound. G-E Dwg. No. A-4031595-P1.	Replaces L125.
L126	Coil; 2 turns at 11-1/2 turns per inch, 0.25-inch ID, of B11B10A5, 0.064 inch Dia. G-E Dwg. No. A-7145060-P1.	Replaced by L206.
L206	Coil; 2 turns, right-hand wound. G-E Dwg. No. A-4031598-P2.	Replaces L126.

Elementary Diagram, Outline Diagram and Text Changes.

Changed delineation of the following:

C161, 22 mmfd to C196.
C163, 22 mmfd to C198.
C164, 22 mmfd to C197.
C162, 7 mmfd to C207, 7 mmfd.
C165, 7 mmfd to C208, 7 mmfd.
L124 to L204.
L125 to L205.
L126 to L206.

Deleted C166.

REV. Q (Models 4ET20A1, 11 only)

REV. S (Models 4ET20A2, 12 only)

Part Changed	Was	Changed To
C113	Added	Capacitor: ceramic, Hi-K disk; 0.0015 mfd + 100% -0%, 500 v d-c w. G-E Dwg. No. C-7774750-P5.

Purpose of Change

To provide RF by-pass for crystal oven heater lead in order to minimize any tendency toward frequency change with oven cycling.

Elementary Diagram Changes

C113, 1500 MMFD was added between XY102-3 and ground.

REV. R (Models 4ET20A1, 11 only)

REV. T (Models 4ET20A2, 12 only)

Purpose of Change

To lengthen relay life and reduce interference in repeater stations.

Part Changed	Was	Changed To
C108	Added	Capacitor: silver mica, dipped phenolic insulation; 47 mmfd ± 5%, 500 v d-c w Electromotive Mfg. Co. Type DM15 G-E Dwg. B-7489162-P19.
R104	Added	Resistor; composition, 22 ohms ± 10%, 2 w. G-E Dwg. C-3R79-P220K.

Elementary Diagram Changes

C108 added across R143, and R104 added in series on connection between R148 and P101-9

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S. A.

PRODUCTION CHANGE SHEET
FOR
RECEIVER MODELS 4ER25C1, 2, 11 & 12, REV. G
RECEIVER MODELS 4ER25D1, 2, 11 & 12, REV. G

Changes listed below are identified by the letter appearing in the REV pad.

REV. A - Changed the frequency range of Receiver Models 4ER25C1 & 11, 4ER25D1 & 11 from the 144-152 MC to 144-150.8 MC and Receiver Models 4ER25C2 & 12, 4ER25D2 & 12 from 152-174 MC to 150.8-174 MC.

Part Changed	Was	Changed To
C371	Capacitor: ceramic, Hi-K, 0.01 mfd +80% -20%, 450 v d-c w. Centralab Type DA-048. G-E Dwg. No. B-7488160-P1.	Deleted.
C386	Added.	Capacitor:ceramic disk, insulated, 6000 mmfd ± 20%, 500 v d-c w. RMC Corp. Type JF discap G-E Dwg. No. B-5494481-P19.
C400	Capacitor: ceramic disk, insulated, 3000 mmfd ± 20% 500 v d-c w. RMC Corp. Type JF Discap G-E Dwg. No. B-5494481-P15.	Capacitor: ceramic disk, insulated, 6000 mmfd ± 20%, 500 v d-c w. RMC Corp. Type JF Discap G-E Dwg. No. B-5494481-P19.
T301	Transformer; Antenna includes the following electrical components with T301 prefix. G-E Dwg. No. PL-7144650-G1.	Deleted.

REV. A (Continued)

Part Changed	Was	Changed To
T322	Transformer: Antenna includes the following electrical components with T322 prefix. G-E Dwg. No. PL-7144650-G2.	Deleted.
T301-C1 and T322-C1	Capacitor: variable air, 1.98 to 7.83 mmfd, 1250 volts peak. EF Johnson Part #160-104-43. G-E Dwg. No. M-7481115-P2.	Deleted.
T301-C2 and T322-C2	Capacitor: ceramic, temp compensating, tubular, 10 mmfd ± 0.25 mmfd, 500 v d-c w, -80 temp coef. G-E Dwg. No. P-7770468-P241.	Deleted.
T301-C3 and T322-C3	Capacitor: variable air 1.98 to 7.83 mmfd, 1250 volts peak. EF Johnson Part #160-104-43. G-E Dwg. No. M-7481115-P2.	Deleted.
T301-C4 and T322-C4	Capacitor: temp compensating, tubular, 6.0 mmfd ± 0.25 mmfd, 500 v d-c w. -80 temp coef. G-E Dwg. No. P-7770466-P237.	Deleted.
T301-C5 and T322-C5	Capacitor: ceramic temp compensating 6.0 mmfd ± 0.25 mmfd, 500 v d-c w. -80 temp coef. G-E Dwg. No. B-7488184-P5.	Deleted.

REV. A (Continued)

Part Changed	Was	Changed To
T301-J1 and T322-J1	Connector: phono type, mica filled phenolic. Similar to Cinch Cat. #14H20190 except silver plated. G-E Dwg. No. K-7104941-P7.	Deleted.
T301-L1, L2 and T322-L1, L2	Coil: 6.5 turns per inch, right hand wound, 0.47 inches ID ± 0.01 inches G-E Dwg. No. A-7145404-P1.	Deleted.
T336	Added.	Transformer: Antenna, includes the following electrical components with T336 prefix. G-E Dwg. No. PL-7144650-G3.
T336-C2	Added.	Capacitor: ceramic, temp compensating, tubular, 10 mmfd ± 0.25 mmfd, 500 v d-c w. -80 temp coef. G-E Dwg. No. P-7770468-P241.
T336-C4	Added.	Capacitor: temp compensating, tubular, 6.0 mmfd ± 0.25 mmfd, 500 v d-c w. -80 temp coef. G-E Dwg. No. P-7770466-P237.
T336-C5	Added.	Capacitor: ceramic, temp compensating, 6.0 mmfd ± 0.25 mmfd, 500 v d-c w. -80 temp coef. G-E Dwg. No. B-7488184-P5.
T336-C8 and T336-C9	Added.	Capacitor: variable, air 2.13 to 8.73 mmfd, 1250 volts peak. G-E Dwg. No. M-7481115-P13.

REV. A (Continued)

Part Changed	Was	Changed To
T336-J1	Added.	Connector: phono type, mica filled phenolic. Similar to Cinch Cat. #14H20190 except silver plated. G-E Dwg. No. K-7104941-P7.
T336-L1 and T336-L2		Coil: 6.5 turns per inch, right hand wound, 0.47 inches ID ± 0.01 inches G-E Dwg. No. A-7145404-P1.
T337	Added.	Transformer: Antenna, includes the following electrical components with T301 prefix. G-E Dwg. No. PL-7144650-G4.
T337-C5	Added.	Capacitor: ceramic, temp compensating, 6.0 mmfd ± 0.25 mmfd, 500 v d-c w. -80 temp coef. G-E Dwg. No. B-7488184-P5.
T337-C6	Added.	Capacitor: ceramic, temp compensating; 14.0 mmfd ± 5%, 500 v d-c w. Erie Type 331. G-E Dwg. No. M-7473485-P14.
T337-C7	Added.	Capacitor: ceramic, temp compensating, tubular, 10 mmfd ± 0.25 mmfd, 500 v d-c w, -80 temp coef. G-E Dwg. No. P-7770468-P241.
T337-C8 and T337-C9	Added.	Capacitor: variable, air 2.13 to 8.73 mmfd, 1250 volts peak. G-E Dwg. No. M-7481115-P13.

REV. A (Continued)

Part Changed	Was	Changed To
T337-J1	Added.	Connector: phono type, mica filled phenolic. Similar to Cinch Cat. #14H20190 except silver plated. G-E Dwg. No. K-7104941-P7.

Elementary Diagram, Service Outline, Block Diagram and Text Changes

T301* Changed to read T336*
T322 Changed to read T337
T301-C1, 1.8-8.7 changed to read T336-C8, 2.0-9.0
C400, 3000 changed to read C400, .006 mfd.
C371, 0.01 mfd changed to read C386, .006 mfd.
144-152 MC changed to read 144-150.8 MC
152-174 MC changed to read 150.8-174 MC
Y301 crystal frequency ranges 11.275-11.942 MC (4ER25C&D1,11) and 11.942-13.775 MC (4ER25C&D2,12) changed to read 11.275-11.842 (4ER25C&D1,11) and 11.842-13.775 MC.

REV. B. - Lowered residual noise under squelch conditions and increased the spurious response attenuation.

Part Changed	Was	Changed To
R343	Resistor: composition, 47000 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P473K	Replaced by R408.
R408	Added in place of R343	Resistor: composition 0.22 megohm ± 10%, 1/2 w. G-E Part No. C-3R77-P224K
C411	Added.	Capacitor: ceramic, Hi-K disk, 0.02 mfd +80% -20%, 450 v d-c w. Centralab Type DA-145. G-E Dwg. No. B-7488160-P2.

REV. B. (continued)

Part Changed	Was	Changed To
C412 and C413	Added.	Capacitor: ceramic disk, insulated, 6000 mmfd ± 20%, 500 V d-c w. RMC Corp. Type JF discap. G-E Dwg. No. B-5494481-P19.

Elementary Diagram Changes

R343, 47 K was replaced by R408, 220 K.
C411, .02 MF was added between XV311-7 and XV311-5.
C412, .006 MF was added between XV302-4 and XV302-5.
C413, .006 MF was added between XV304-4 and XV304-9.

REV. C - Mechanical Simplification

Part Changed	Was	Changed To
C339	Capacitor: ceramic, Hi-K disk, 0.02 mfd + 100% - 0%, 500 v d-c w. G-E Dwg. No. C-7774750-P15.	Deleted.
C394	Capacitor: ceramic, Hi-K disk, 0.02 mfd, +80% -20%, 450 v d-c w. Centralab Type DA-145. G-E Dwg. No. P-7488160-P2.	Deleted.
C414	Added in place of C339 and C394.	Capacitor: Mylar-dielectric, 0.047 mfd, ± 20%, 50 v d-c w. Similar to Goodall Type 601 PE. G-E Dwg. No. B-5491189-P4.

Elementary Diagram Changes

C339, .02 MF and C394, .02 MF were replaced by C414, .047 MF.

REV. D - Allows operation of squelch in the center of squelch control.

Part Changed	Was	Changed To
R344	Resistor: composition; 24,000 ohms ± 5%, 1/2 w. G-E Part No. C-3R77-P243J.	Replaced by R412.
R412	Added in place of R344.	Resistor: composition; 20,000 ohms ± 5%, 1/2 w. G-E Part No. C-3R77-P203J.

Elementary Diagram Changes

R344, 24K was replaced by R412, 20K.

REV. E - Raises maximum squelch sensitivity.

Part Changed	Was	Changed To
R412	Resistor: composition; 20,000 ohms ± 5%, 1/2 w. G-E Part No. C-3R77-P203J.	Resistor: composition; 27,000 ohms ± 5%, 1/2 w. G-E Part No. C-3R77-P273J.

Elementary Diagram Changes

Changed R412, 20K to R412, 27K.

REV. F - Provides greater squelch rotation between open and critical squelch.

Part Changed	Was	Changed To
R340	Resistor; composition, 0.39 megohms ± 10%, 1/2 w. G-E Part No. C-3R77-P394K.	Replaced by R415.
R415	Added in place of R340.	Resistor: composition, 0.27 megohms ± 10%, 1/2 w. G-E Part No. C-3R77-P374K.

REV. G. - To improve clipping characteristics.

Part Changed	Was	Changed To
R355 and R408	Resistor: composition, 0.22 megohm ± 10%, 1/2 w. G-E Part No. C-3R77-P224K.	Deleted.
R412	Resistor: composition, 27,000 ohms, ± 5%, 1/2 w. G-E Part. No. C-3R77-P273J.	Resistor: composition 24,000 ohms ± 5%, 1/2 w. G-E Part No. C-3R77-P243J.
R419	Added.	Resistor: composition 47,000 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P473K.
R420	Added.	Resistor: composition, 68,000 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P683K.
R421	Added.	Resistor: composition, 0.15 megohm ± 10%, 1/2 w. G-E Part No. C-3R77-P154K.
C424	Added.	Capacitor: ceramic Hi-K disk, 0.02 mfd +80% -20%, 450 v d-c w. Centralab Type DA-145. G-E Dwg. No. B-7488160-P2.

REV. G (Continued)

Elementary Diagram Changes

R408, 220K was changed to read R419, 47K
R412, 27K was changed to read R412, 24K

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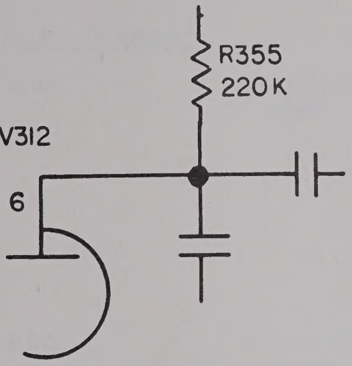
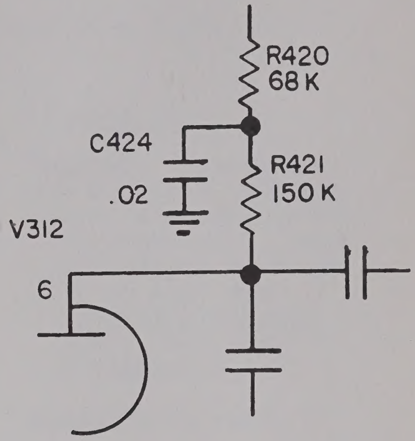

R355
220K
V312
6

Changed To:


R420
68K
C424
.02
R421
150K
V312
6

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.

PRODUCTION CHANGE SHEET FOR POWER SUPPLY MODELS 4EP2E1 & F1, REV. K

Changes listed below are identified by the REV. letter appearing after the Model Number stamped on the lip of the Power Supply chassis.

REV. A

Part Changed	Was	Changed To
L506	Added in place of R540.	Reactor: inductance 1.5 h at 0.085 amps d-c, d-c resistance 150 ohms max., peak a-c ripple 10 v RMS at 60 cps, d-c operating voltage 200 v. G-E Dwg. B-7489398-P1.
R540	Resistor: wirewound wire leads, 200 ohms ± 10%, 5 w. G-E Dwg. B-7487415-P21.	Replaced by L506.
R542	Resistor: composition, 47 ohms ± 10%, 2 w. G-E Dwg. C-3R79-P470K.	Replaced by R565.
R565	Added in place of R542	Resistor: composition, 47 ohms ± 10%, 1/2 w. G-E Dwg. C-3R77-P470K.

Text Change

References to R540 and R542 (EBI-41090, pp. 2 and 4) were changed to L506 and R565, respectively.

Elementary Change

R540 (200 ohms, 5-watt) was changed to L506 (1.5 henries) and R542 (47 ohms, 2-watt) was changed to R565 (47 ohms, 1/2-watt).

REV. B

Part Changed	Was	Changed To
W501	Cable assembly G-E Dwg. B-7488632-P1.	Cable assembly G-E Dwg. C-7775913-P2.

Text and Elementary Diagram Changes

None.

REV. C

Part Changed	Was	Changed To
J505	Test Point Jack: phenolic or urea, red. G-E Part No. A-7143966-P2.	Replaced by J518.
J507	Test Point Jack: phenolic or urea, red. G-E Part No. A-7143966-P2.	Replaced by J520.
J508	Test Point Jack: phenolic or urea, black. G-E Part No. A-7143966-P1.	Replaced by J521.
J518 J520 & J521	Added in place of J505, J507 and J508.	Jack, metering: 4-point, molded phenolic. Similar Cinch Part #9800 except contact elements are made for 0.080-inch pins. G-E Part No. A-7160854-P1.

Text, Service Outline and Elementary Diagram Changes

References to J505, J507 and J508 were changed to J518, J520 and J521, respectively.

REV. D

Part Changed	Was	Changed To
CR503 and CR511	Selenium Rectifier: forward current 120 ma, peak inverse 380 v per arm, connected for doubler. G-E Part No. A-7144141-P2.	Selenium Rectifier: forward current 80/30 ma d-c, peak inverse 800 v per arm, connected for doubler. G-E Part No. A-7144141-P3.

REV. E

Part Changed	Was	Changed To
S501	Switch: Push button type, momentary contact, SP NO, red button, 1/2-amp at 115 v a-c. Grayhill Cat. #4001. G-E Dwg. No. M-7481654-P1.	Deleted.

REV. F

Part Changed	Was	Changed To
S501	Added.	Switch: Push button type, momentary contact, SP NO. red button, 1/2-amp at 115 v a-c. Grayhill Cat. #4001. G-E Dwg. No. M-7481654-P1.

REV. G - To improve reliability by using high quality silicon rectifiers.

Part Changed	Was	Changed To
CR503 and CR511	Rectifier; selenium; forward current 80/30 ma d-c, peak inverse 800 v per arm, connected for doubler. G-E Cat. #6RS21PD13BAF1. G-E Dwg. No. A-7144141-P3.	Replaced by CR525 thru CR532.
CR504	Rectifier: selenium; forward current 50 ma, peak inverse 700 v per arm, entire stack connected for center tap. G-E Cat. #6RS21PC12BA1. G-E Part #A-7144141-P1.	Replaced by CR533 and CR534.
CR505	Rectifier; selenium; 1 cell, forward current 150 ma, peak inverse 64 v, connected for half-wave. G-E Cat #6RS21PH1ATF1. G-E Part No. A-7140806-P1.	Replaced by CR535.
CR506 and CR507	Rectifier: selenium forward current 50 ma, peak inverse 800 v per arm, connected for doubler. G-E Cat. #6RS21PD12BB1. G-E Dwg. No. A-7144141-P2.	Replaced by CR517 thru CR524 on Model 4EP2F1 only.

REV. G (cont'd)

Part Changed	Was	Changed To
CR512	Rectifier: selenium bridge connected, 18 v d-c, current 720 ma d-c, 22 v a-c new, 26 v a-c aged. G-E Cat. #6RS22GB1ATD1. G-E Dwg. No. B-7486514-P1.	Replaced by CR538 thru CR541.
CR517 thru CR535 and CR538 thru CR541	Added in place of selenium rectifiers.	Rectifier: silicon, half-wave, peak volts 400, capacitive load inverse 300, resistive load 500 ma. Similar to Westinghouse 1N1199. G-E Dwg. No. B-5490415-P2.
R595 and R596	Added.	Resistor: composition, 10 ohms ± 10%, 2 w. G-E Part No. C-3R79-P100K.
R572	Added.	Resistor: composition, 470 ohms ± 10%, 1/2 w. G-E Part No. C-3R77-P471K.
C549	Added.	Capacitor: ceramic, Hi-K disk; 0.02 mfd +100% -0%, 500 v d-c w. G-E Dwg. No. C-7774750-P15.

REV. G (cont'd)

Elementary Diagram Changes

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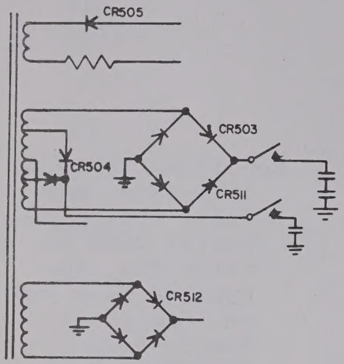
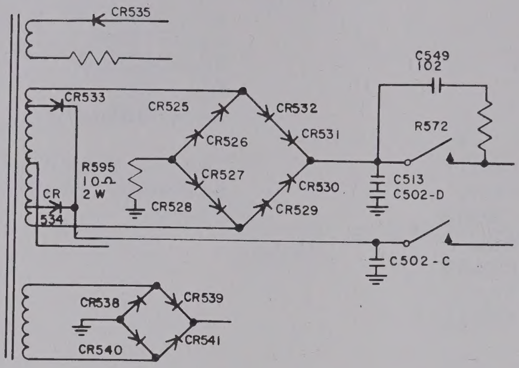

CR505
CR503
CR504
CR511
CR512

Changed To:


CR535
C549
102
CR533
CR525
CR532
CR531
R572
CR526
R595
10Ω
2 W
CR527
CR530
C513
C502-D
CR
534
CR528
CR529
C502-C
CR538
CR539
CR540
CR541

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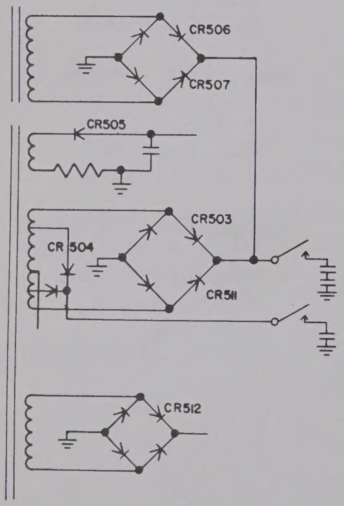
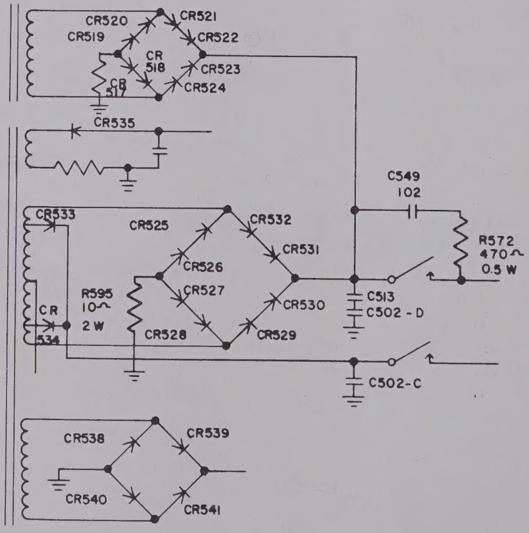

CR506
CR507
CR505
CR503
CR 504
CR511
CR512

Changed To:


CR520
CR521
CR519
CR522
CR
518
CR523
CR
517
CR524
CR535
C549
102
CR533
CR525
CR532
CR531
R572
470Ω
0.5 W
CR526
CR527
R595
10Ω
2 W
CR530
C513
C502 - D
CR
534
CR528
CR529
C502-C
CR538
CR539
CR540
CR541

REV. G (cont'd)

Service Outline Changes

Added silicon rectifiers in place of selenium rectifiers.

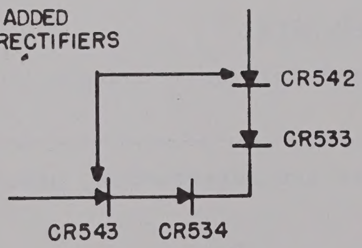
Text Changes

References to CR503 thru CR507 and CR511, CR512 were changed to CR517 thru CR535 and CR538 thru CR541.

REV. H - To adjust circuit so that voltages are well within rectifier ratings.

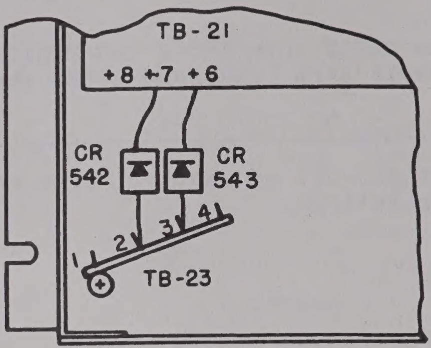
Part Changed	Was	Changed To
CR542 and CR543	Added.	Rectifier: silicon, halfwave, peak volts 400, capacitive load inverse 300, resistive load 500 ma. Similar to Westinghouse 1N1199. G-E Dwg.No. B-5490415-P2.

Elementary Diagram Changes



REV. H (cont'd)

Outline Diagram Changes



REV. J - To increase wattage rating of metering resistors to prevent occasional failure at high line voltages.

Part Changed	Was	Changed To
R601	Added in place of R510	Resistor, composition, 150 v, ± 10%, 1 watt, G.E. Dwg. No. C3R78P154J.
R602	Added in place of R511	Same as above

Elementary Diagram Changes

References to R510 and R511 were changed to R601 and R602.

REV. K - To optimize relay arc suppression, assuring longer relay life.

Part Changed	Was	Changed To
R572	Resistor, composition, 470 ohms ± 10%, 1/2 w. G.E. Dwg. No. C-3R77-P471K	Replaced by R604

REV. K (cont'd)

Part Changed	Was	Changed To
R604	Added in place of R572	Resistor, composition, 47 ohm ± 10%, 1/2 w G.E. Dwg. No. C-3R77-P470K

Elementary Diagram Changes

Reference to R572 was changed to R604, and new values listed.

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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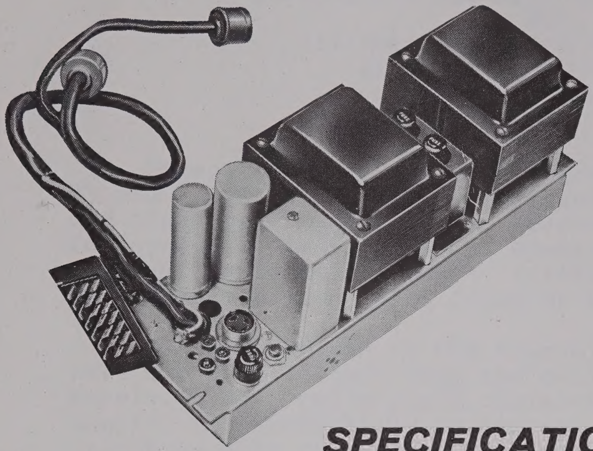
PROGRESS LINE AC MOBILE POWER SUPPLIES



SPECIFICATIONS

Type EP-2-F

Description	A-C power supply for high-power stations housed in mobile type case.
Nominal input voltage	117 VAC, 60 cps
Nominal power input	USED WITH SERIES — Standby — Transmit 16 — 87 watts — 235 watts 36 — 85 watts — 280 watts
Output capacity	To transmitter: 425 volts at 320 milliamperes 300 volts at 120 milliamperes 200 volts at 10 milliamperes —25 volts bias To receiver: 197 volts at 85 milliamperes To filaments: 6.3 volts at 8 amperes To relays: 6.3 volts at 650 milliamperes
Ambient temperature range	—30° to +60° C
Type of circuit	Tapped, full-wave bridge using transformer and high-temperature silicon rectifier cells.
Duty cycle	Standby: continuous Transmit: EIA 20%
Size	13½'' long x 6'' high x 4¼'' wide
Weight	21 pounds

The equipment described above meets or exceeds all applicable EIA specifications.

SCOPE OF SPECIFICATION—In the construction of the equipment described herein, the full intent of the specification will be met. Departures from the specifications however, may occur if desirable for reasons of improved design or operation.

GENERAL ELECTRIC

COMMUNICATION PRODUCTS DEPARTMENT
LYNCHBURG, VIRGINIA

ECR 236G Printed in U. S. A.

DESCRIPTION AND MAINTENANCE INSTRUCTIONS
FOR
117-VOLT AC MOBILE POWER SUPPLIES
MEDIUM-POWER MODEL 4EP2E1
HIGH-POWER MODEL 4EP2F1

General Electric AC Mobile Power Supply Models 4EP2E1 & F1 are Progress Line units designed for use with medium-power and high-power transmitters, respectively, and their receivers for operation from 117-volt, 60-cycle a-c line power. This combination forms a compact, efficient station for 2-way radio communication with other fixed or mobile stations.

All connections to the transmitter, receiver and control unit are made through plug and cable connections to the power supply. This permits rapid replacement of either the power supply, the transmitter or the receiver, using only a screwdriver to make the change. Jacks are provided for metering the transmitter and receiver B-plus voltages, but no voltages are exposed above the power supply chassis. Metering may be done with a 20,000 ohm-per-volt voltmeter having a 0 to 3 volt scale. Components and wiring points are fully accessible for servicing.

Although normally used with a controlled-reluctance microphone, the power supply may be quickly modified for use with a carbon microphone.

MAINTENANCE

To obtain optimum performance from the equipment, a program of regular preventive maintenance should be followed. This preventive maintenance should include the following:

1. A mechanical inspection of the unit for loose, broken or damaged components.

2. An inspection of the power and control cable connections.

3. Measurement of the transmitter B-plus and receiver B-plus voltages at the "HB+" jack, J520 (red-positive), and at the "LB+" jack, J518 (red-positive), respectively. A 1-volt deflection on a 20,000 ohm-per-volt meter at the "HB+" jack indicates a transmitter B-plus voltage of 200 volts. A 1-volt deflection at the "LB+" jack indicates 100 volts of

receiver B-plus on RECEIVE or 100 volts of transmitter oscillator B-plus on TRANSMIT. Compare the voltages read at these jacks with those given on the SERVICE OUTLINE for the power supply.

4. A check of the input voltage.

5. A check of the relay contacts as described in the following section.

RELAY MAINTENANCE

The relays used in these units require little care. They should be inspected periodically, however, to assure maximum operating efficiency. If the contacts become pitted, they should be cleaned with a burnishing tool to smooth out any metallic deposits. When relay contacts carry little or no current, the contacts do not clean themselves and an insulating coating is apt to form. This coating may be removed by cleaning the contacts with a burnishing tool. Do not oil the relay bearings. When relays are in dusty locations, lubricated bearings will collect dust and grit and will wear more rapidly than non-lubricated bearings. Some of the relays used are of the multiple-contact type and, in the unenergized position, should have contact spacings of approximately .1625 to .125 inch. More important, the contact spacings on any multiple-contact relay should be equal so that the contact pressures will be equal when the relay is energized. The back pressure of the antenna relay should be at least 15 grams. Low back pressure will shorten the life of contacts, due to excessive arcing, and may also cause noise in the receiver, due to the chatter of the antenna relay contact under vibration.

CIRCUIT ANALYSIS

AC Mobile Power Supply Models 4EP2E1 & F1 supply all operating voltages for the mobile transmitter and receiver. All connections to these units, both power and control, are made through a cable (W501) from the power supply. Closing the power switch on the control unit applies 117 volts a-c through terminals 8 and 12 of jack J502 and fuses F503 and/or F504 to the primary windings of transformers T507 and/or T508.

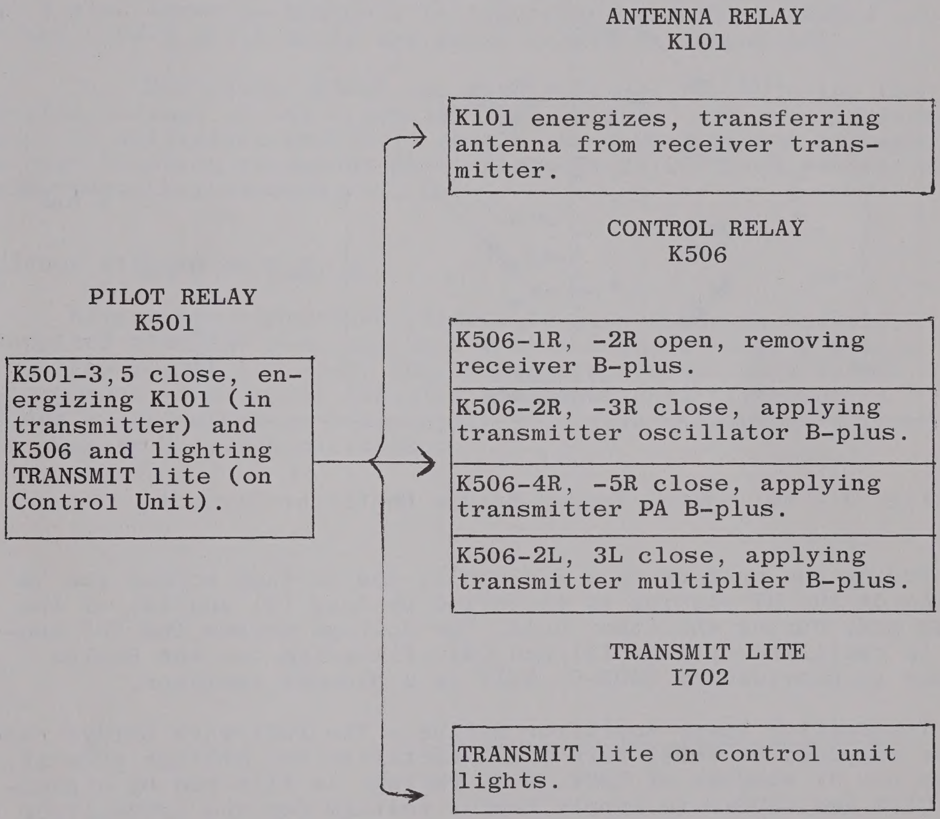
RECEIVER SUPPLY VOLTAGE CIRCUITS

The a-c voltage developed across the HV secondary winding R-R (red lead to red lead) of T507 is rectified by the Y-BK-Y half of rectifier bridge CR525 thru CR532. The receiver

B-plus voltage is taken at center tap RY of the HV winding and filtered by an RC network composed of C502-A and B, L506, R541, R565 and C504-A and B. Fuse F501 fuses the receiver B-plus voltage. 6.3 volts a-c for the receiver and transmitter filaments is furnished by secondary winding G-G on transformer T507.

RELAY CIRCUITS

Keying the transmitter, by closing the test switch (S501) or by pressing the microphone button (connected either at the control unit or at J509 on the power supply chassis), energizes relay K501, which then initiates the sequence outlined in Fig. 1.



PILOT RELAY
K501

K501-3,5 close, energizing K101 (in transmitter) and K506 and lighting TRANSMIT lite (on Control Unit).

ANTENNA RELAY
K101

K101 energizes, transferring antenna from receiver transmitter.

CONTROL RELAY
K506

K506-1R, -2R open, removing receiver B-plus.

K506-2R, -3R close, applying transmitter oscillator B-plus.

K506-4R, -5R close, applying transmitter PA B-plus.

K506-2L, 3L close, applying transmitter multiplier B-plus.

TRANSMIT LITE
I702

TRANSMIT lite on control unit lights.

Fig. 1 - Sequence of Operation When Transmitter is Keyed

DC voltage for operating the relays is supplied by the silicon rectifier bridge CR538 thru CR541, which rectifies the a-c voltage developed across the BR-BR secondary winding of T507.

TRANSMITTER B-PLUS AND BIAS CIRCUITS

Transmitter Oscillator B-Plus - With the power supply keyed, the a-c voltage developed across the HV secondary winding of T507 is rectified by the Y-BK-Y half of rectifier bridge CR525 thru CR532. The transmitter oscillator B-plus voltage is taken at the RY center tap of the HV winding and filtered by an RC network composed of C502-A and B, L506, R541 and C504-A.

Transmitter Multiplier B-Plus - The B-plus voltage for the transmitter multiplier stages is obtained by using a full-wave, tapped-bridge rectifier circuit. A simplified diagram of the circuit is shown in Fig. 2.

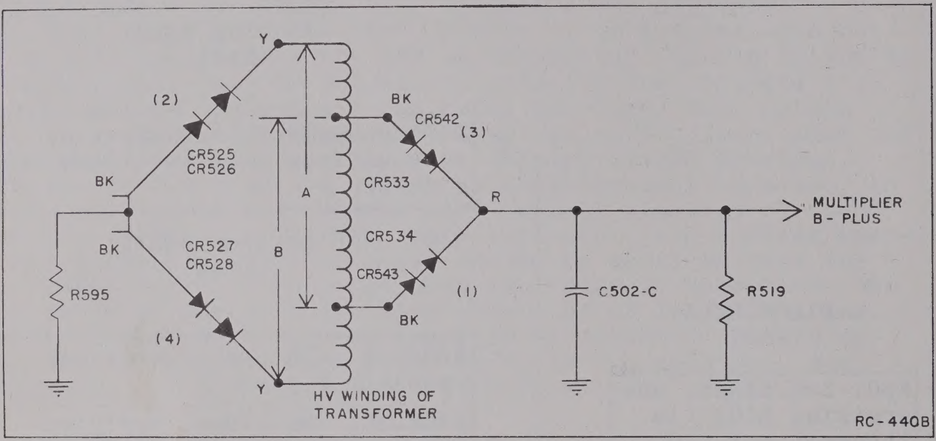


Fig. 2 - Full-Wave, Tapped-Bridge Rectifier Circuit

During one half of each a-c cycle, the voltage across the "A" section of the HV winding is rectified by legs (1) and (2) of the bridge and, during the other half, the voltage across the "B" section is rectified by legs (3) and (4). Filtering for the B-plus voltage is provided by C502-C. R519 is a bleeder resistor.

Transmitter Power Amplifier B-Plus - The full-wave bridge rectifier composed of CR525 thru CR532 rectifies the voltage present across the HV winding of T507. This voltage is filtered by capacitors C513 and C502-D to supply B-plus voltage for the transmitter PA stage. In Power Supply Model 4EP2F1, the output of transformer T508, rectified by full-wave rectifier bridge CR517 thru CR524, is connected in parallel with the output of rectifier bridge CR525 thru CR532 to increase the power output of the PA B-plus supply to meet the requirements of the High-Power Transmitter.

Transmitter Negative Bias - The a-c voltage across the BL-BL secondary winding of transformer T507 is rectified by half-wave rectifier CR535 and filtered by C506 to supply negative bias for the transmitter 4th multiplier and power amplifier control grids. This negative bias is present as a protective measure to limit cathode current in the PA tube when the PA is untuned. R509 in the bias supply is a surge-limiting resistor.

METERING CIRCUITS

The voltage read at the "LB+" jack (J518) must be multiplied by 100 to obtain the actual voltage across metering resistors R513 and R514. On RECEIVE, this will be the receiver B-plus voltage, but on TRANSMIT, the B-plus voltage for the oscillator stage of the transmitter will be read here. R513 and R514 also serve as bleeders to discharge capacitors C502-A and B and C504-A and B after the power supply is turned off.

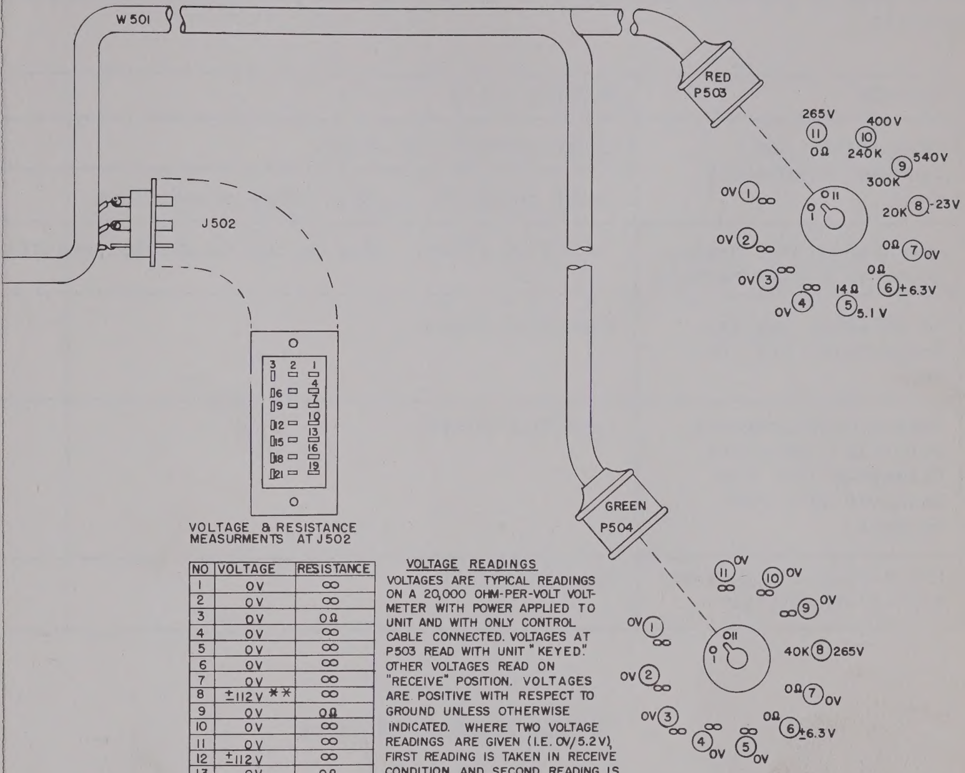
The "HB+" jack (J520) has been provided for metering the B-plus voltage on the transmitter PA tube(s). The meter reading must be multiplied by 200 to obtain the actual B-plus voltage across metering resistors R510, R511 and R512. These resistors also serve as bleeders.

CARBON MICROPHONE KIT

Although a controlled-reluctance microphone is normally supplied with the Progress Line Mobile Combinations, a single modification of the Power Supply permits the use of a carbon microphone. A dropping resistor and additional filtering is added to the negative bias supply to obtain microphone current to operate a carbon microphone.

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.


W501
J502
RED
P503
265V
11
0Ω
400V
10
240K
540V
9
300K
20K 8 -23V
0Ω 7 0V
0Ω
6 ±6.3V
14Ω
5 5.1 V
0V 4 ∞
0V 3 ∞
0V 2 ∞
0V 1 ∞
GREEN
P504
11 0V ∞
10 0V ∞
9 0V ∞
40K 8 265V
0Ω 7 0V
0Ω 6 ±6.3V
5 0V ∞
4 0V ∞
0V 3 ∞
0V 2 ∞
0V 1 ∞
3 2 1 4 6 7 9 10 12 13 15 16 18 19 21

VOLTAGE & RESISTANCE MEASURMENTS AT J502

NO	VOLTAGE	RESISTANCE
1	0V	∞
2	0V	∞
3	0V	0Ω
4	0V	∞
5	0V	∞
6	0V	∞
7	0V	∞
8	±112V **	∞
9	0V	0Ω
10	0V	∞
11	0V	∞
12	±112V	∞
13	0V	0Ω
14	±6.3V	0Ω
15	0V	450Ω
16	0V	∞
17	0V/5.2V	14Ω
18	7.8V/0V	165Ω
19	0V	∞
20	0V	∞
21	0V	∞

** MEASURED BETWEEN PINS 8 AND 12.

VOLTAGE READINGS

VOLTAGES ARE TYPICAL READINGS ON A 20,000 OHM-PER-VOLT VOLTMETER WITH POWER APPLIED TO UNIT AND WITH ONLY CONTROL CABLE CONNECTED. VOLTAGES AT P503 READ WITH UNIT "KEYED". OTHER VOLTAGES READ ON "RECEIVE" POSITION. VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED. WHERE TWO VOLTAGE READINGS ARE GIVEN (I.E. 0V/5.2V), FIRST READING IS TAKEN IN RECEIVE CONDITION AND SECOND READING IS TAKEN WITH UNIT KEYED.

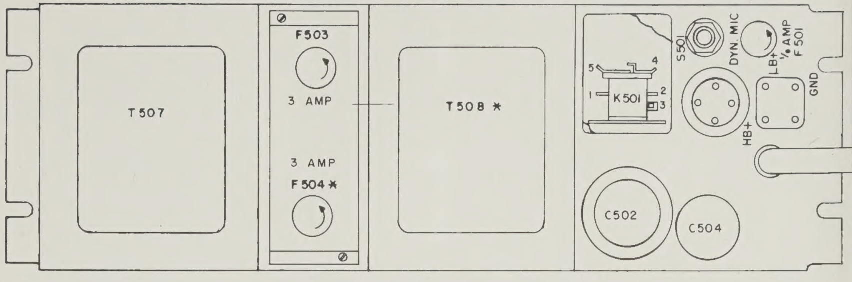
RESISTANCE READINGS

RESISTANCES ARE TYPICAL READINGS FROM METERING POINTS TO GROUND WITH ALL CABLES DISCONNECTED FROM THE UNIT, AND ALL POWER REMOVED.

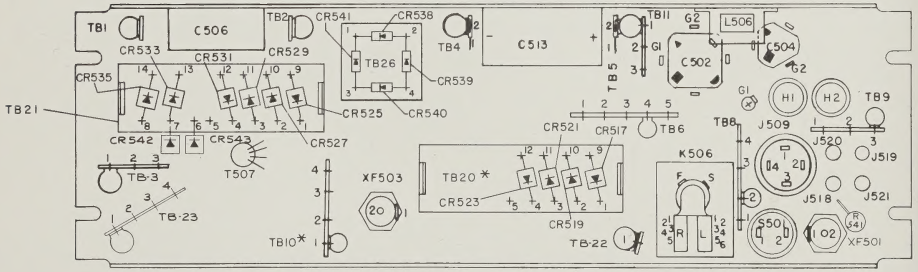
Service Outline

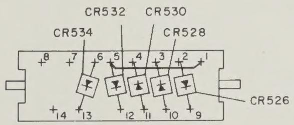
AC MOBILE POWER SUPPLY
MODELS 4EP2E1 & F1

(D-7667955, Rev. 7)

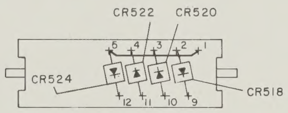

T507
F503
3 AMP
3 AMP
F504 *
T508 *
S501
DYN MIC
LB+
1/4 AMP
F501
K501
GND
HB+
C502
C504

* PRESENT ONLY ON MODEL 4EP2F1

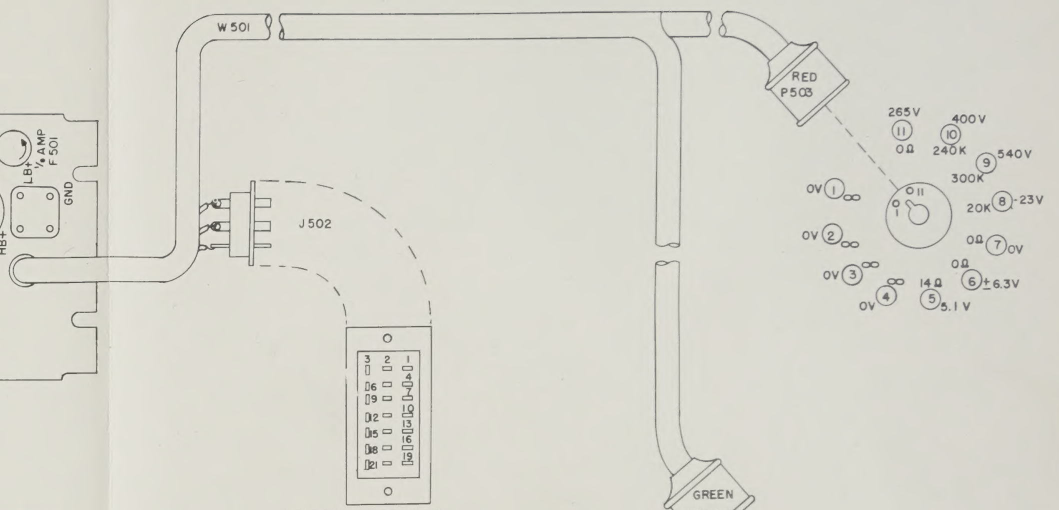

TB1
C506
TB2
CR541
CR538
TB26
CR539
CR540
TB4
C513
TB11
G2
L506
G1
C502
C504
TB5
CR533
CR531
CR529
CR535
TB21
CR525
CR527
CR542
CR543
T507
TB-3
TB-23
XF503
TB10*
TB20 *
CR523
CR521
CR517
CR519
TB6
TB8
K506
J509
J520
TB9
J519
H1
H2
J518
J521
S501
102
XF501
TB-22


CR532
CR530
CR534
CR528
CR526

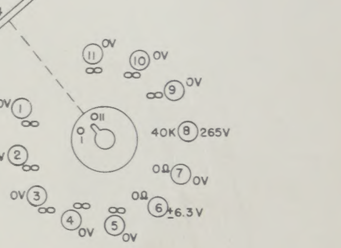
TB21
REAR VIEW


CR522
CR520
CR524
CR518

TB20
REAR VIEW


W501
J502
RED
P503
265V
0Ω
400V
240K
540V
300K
20K
-23V
0Ω
0V
0Ω
±6.3V
14Ω
5.1V
0V
0V
0V
0V
∞

VOLTAGE & RESISTANCE
MEASURMENTS AT J502


GREEN
P504
0V
0V
0V
40K
265V
0Ω
0V
0Ω
±6.3V
0V
0V
0V
0V
0V
∞

NO	VOLTAGE	RESISTANCE
1	0V	∞
2	0V	∞
3	0V	0Ω
4	0V	∞
5	0V	∞
6	0V	∞
7	0V	∞
8	±112V **	∞
9	0V	0Ω
10	0V	∞
11	0V	∞
12	±112V	∞
13	0V	0Ω
14	±6.3V	0Ω
15	0V	450Ω
16	0V	∞
17	0V/5.2V	14Ω
18	7.8V/0V	165Ω
19	0V	∞
20	0V	∞
21	0V	∞

** MEASURED BETWEEN PINS 8 AND 12.

VOLTAGE READINGS

VOLTAGES ARE TYPICAL READINGS ON A 20,000 OHM-PER-VOLT VOLTMETER WITH POWER APPLIED TO UNIT AND WITH ONLY CONTROL CABLE CONNECTED. VOLTAGES AT P503 READ WITH UNIT "KEYED." OTHER VOLTAGES READ ON "RECEIVE" POSITION. VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED. WHERE TWO VOLTAGE READINGS ARE GIVEN (I.E. 0V/5.2V), FIRST READING IS TAKEN IN RECEIVE CONDITION AND SECOND READING IS TAKEN WITH UNIT KEYED.

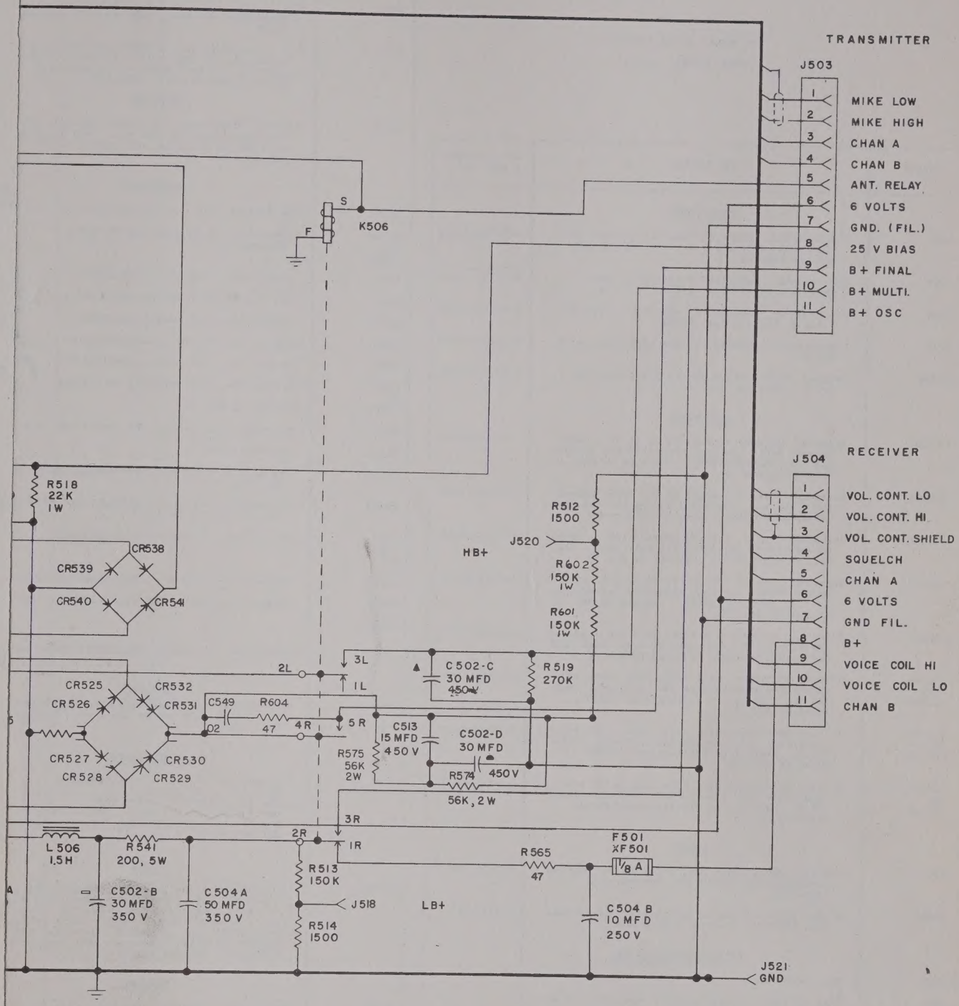
RESISTANCE READINGS

RESISTANCES ARE TYPICAL READINGS FROM METERING POINTS TO GROUND WITH ALL CABLES DISCONNECTED FROM THE UNIT, AND ALL POWER REMOVED.

Service Outline

AC MOBILE POWER SUPPLY
MODELS 4EP2E1 & F1

(D-7667955, Rev. 7)


TRANSMITTER
J503
1 MIKE LOW
2 MIKE HIGH
3 CHAN A
4 CHAN B
5 ANT. RELAY
6 6 VOLTS
7 GND. (FIL.)
8 25 V BIAS
9 B+ FINAL
10 B+ MULTI.
11 B+ OSC
S
F
K506
RECEIVER
J504
1 VOL. CONT. LO
2 VOL. CONT. HI
3 VOL. CONT. SHIELD
4 SQUELCH
5 CHAN A
6 6 VOLTS
7 GND FIL.
8 B+
9 VOICE COIL HI
10 VOICE COIL LO
11 CHAN B
R518 22 K 1W
R512 1500
J520
HB+
R602 150 K 1W
R601 150 K 1W
CR538
CR539
CR540
CR541
2L
3L
1L
C502-C 30 MFD 450 V
R519 270K
CR525
CR532
CR526
CR531
C549 .02
R604 47
4R
5R
C513 15 MFD 450 V
C502-D 30 MFD 450 V
R575 56K 2W
R574 56K, 2 W
CR527
CR530
CR528
CR529
3R
2R
1R
L 506 1.5 H
R 541 200, 5W
R565 47
F501 XF501 1/8 A
C502-B 30 MFD 350 V
C 504 A 50 MFD 350 V
R513 150 K
J518
LB+
R514 1500
C504 B 10 MFD 250 V
J521 GND

Elementary Diagram

MED. POWER AC MOBILE POWER SUPPLY MODEL 4EP2E1, REV. K

(D-7668891, Rev. 18)

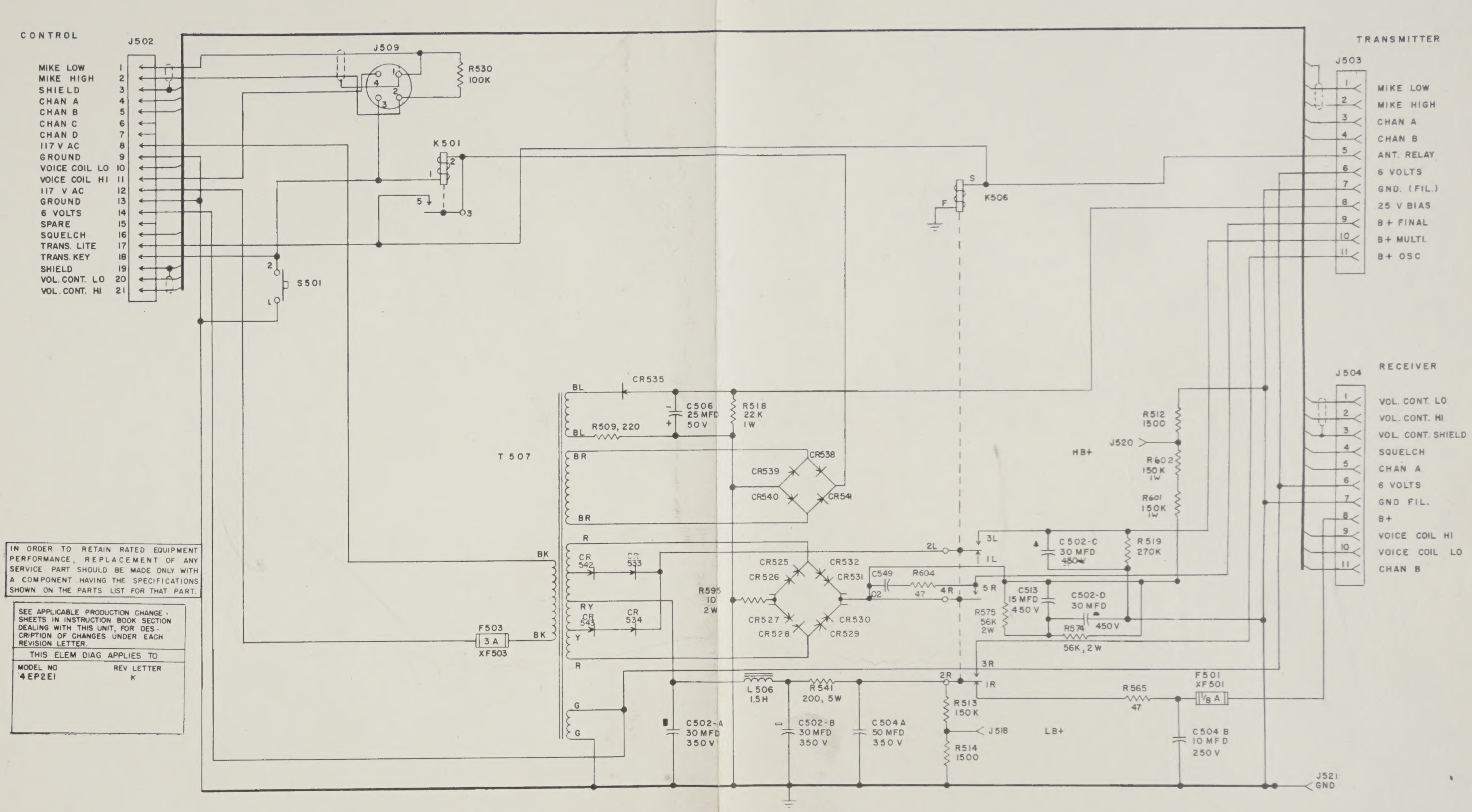
HINTS FOR SERVICING

The following list of service hints, in addition to the table of Typical Metering Voltages and the Voltage-Resistance Chart (see reverse side of page) will assist the serviceman in locating the source of trouble if the Power Supply should fail to operate properly.

SYMPTOM	SERVICE HINTS
Transmitter and receiver completely dead.	Check control unit fuse. Check power and control cable connections.
Low Transmitter B-plus. Receiver B-plus normal.	Fuse F504 blown. (May be due to shorted rectifier.)
No filament voltage. Transmitter will not key.	Fuse F503 blown.
Transmitter operates normally. Receiver filaments lit, but Receiver will not operate.	Fuse F501 blown.
Low B-plus on Receiver and/or Transmitter.	Open rectifier.

TYPICAL METERING VOLTAGES

METER JACK		CIRCUIT	MULTIPLY METER READING BY		
				RECEIVE	TRANSMIT
LB+	J518	Receiver B-plus (on receive), Transmitter Oscillator B-plus (on transmit)	100	195 volts	195 volts
HB+	J520	Transmitter PA B-plus	200	- - - - -	410 volts


CONTROL
J502
MIKE LOW 1
MIKE HIGH 2
SHIELD 3
CHAN A 4
CHAN B 5
CHAN C 6
CHAN D 7
117 V AC 8
GROUND 9
VOICE COIL LO 10
VOICE COIL HI 11
117 V AC 12
GROUND 13
6 VOLTS 14
SPARE 15
SQUELCH 16
TRANS. LITE 17
TRANS. KEY 18
SHIELD 19
VOL. CONT. LO 20
VOL. CONT. HI 21
J509
R530 100K
K501
S501
K506
TRANSMITTER
J503
1 MIKE LOW
2 MIKE HIGH
3 CHAN A
4 CHAN B
5 ANT. RELAY
6 6 VOLTS
7 GND. (FIL.)
8 25 V BIAS
9 B+ FINAL
10 B+ MULTI.
11 B+ OSC
RECEIVER
J504
1 VOL. CONT. LO
2 VOL. CONT. HI
3 VOL. CONT. SHIELD
4 SQUELCH
5 CHAN A
6 6 VOLTS
7 GND FIL.
8 B+
9 VOICE COIL HI
10 VOICE COIL LO
11 CHAN B
T 507
BL
BR
BK
R
RY
Y
G
CR535
C506 25 MFD 50 V
R518 22K 1W
R509, 220
CR538
CR539
CR540
CR541
CR 542
CR 533
CR 543
CR 534
F503 3A XF503
CR525
CR526
CR527
CR528
CR532
CR531
CR530
CR529
R595 10 2W
C549 .02
R604 47
2L
1L
3L
4R
5R
3R
2R
1R
C502-C 30 MFD 450 V
R519 270K
C513 15 MFD 450 V
C502-D 30 MFD 450 V
R575 56K 2W
R574 56K, 2 W
R512 1500
J520
HB+
R602 150K 1W
R601 150K 1W
L506 1.5H
R541 200, 5W
C502-A 30 MFD 350 V
C502-B 30 MFD 350 V
C504 A 50 MFD 350 V
R513 150K
J518
LB+
R514 1500
R565 47
F501 XF501 1/8 A
C504 B 10 MFD 250 V
J521 GND

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
4EP2E1	K

Elementary Diagram

MED. POWER AC MOBILE POWER SUPPLY MODEL 4EP2E1, REV. K

(D-7668891, Rev. 18)

PARTS LIST

CONTROL UNIT FRONT MOUNT

MODEL 4EC29A1,11,2,12

Symbol	Description	G-E Dwg. & Part Number
	INDICATING DEVICES	
I701 and I702	Lamp, incandescent miniature bayonet base, long bulb. 6.3 v, 0.15 amp at 6.8 v. G-E Cat. No. 47.	
	JACKS AND RECEPTACLES	
J701	Chassis, connector: 4 female contacts. Amphenol Type 91-PC4F.	K-7117934-P2
	LOUDSPEAKERS	
LS701	Speaker, permanent magnet, 3-1/2" voice coil impedance 3.2 ohm ± 10%, cone resonance 200 to 325 cps, 2 w.	B-7487536-P1
	PLUGS	
P701	21 female contacts HB Jones Cat. #S-321.	A-7144137-P1
P702	4-pin male cable clamp in top, with latches. HB Jones Cat. No. P-304-CCT-L. (Part of PL-7145244-G1)	B-7488601-P1

EBI-41263G

PARTS LIST
AC MOBILE POWER SUPPLY
MODEL 4EP2E1, Rev. K

SYMBOL	DESCRIPTION	G-E DRAWING & PART NO.
	CAPACITORS	
C502	Electrolytic, polarized twist prong base, 30 mfd + 50% -10%, 450 v d-c w. 30-30-30 mfd Mallory Type FP.	P-7772415-P46
C504	Electrolytic, polarized twist prong base, 50/10 mfd +100% -10%, 350/250 v d-c w.	P-7772415-P24
C506	Electrolytic, tubular, 25 mfd +250% -10%, 50 v d-c w. Mallory Cat. #TC36.	C-7774786-P8[illegible]
C513	Electrolytic, tubular, 15 mfd +50% -10%,450 v d-c w.	C-7774786-P42
C549#	Ceramic, Hi-K disk; 0.02 mfd +100% -0%, 500 v d-c w. Added by Rev. G.	C-7774750-P15
	RECTIFIERS	
CR503#	Selenium; forward current 80/30 ma d-c, peak inverse 800 v per arm, connected for doubler. G-E Cat. #6RS21PD13BAF1. Changes by Rev. D. Deleted by Rev. G.	A-7144141-P3
CR504#	Selenium; forward current 50 ma, peak inverse 700 v per arm, connected for center tap. G-E Cat.#6RS21PC12BA1. Deleted by Rev. G.	A-7144141-P1
CR505#	Selenium; 1 cell, forward current 150 ma, peak inverse 64 v, connected for half wave. G-E Cat. #6RS21PH1ATF1. Deleted by Rev. G.	A-7140806-P1
CR511#	Selenium; forward current 80/30 ma d-c, peak inverse 800 v per arm, connected for doubler. G-E Cat. #6RS21PD13BAF1. Changed by Rev. D. Deleted by Rev. G.	A-7144141-P3
CR512#	Selenium; bridge connection, 18 v d-c, current 720 ma d-c, 22 v a-c new, 26 v a-c aged. G-E Cat. #6RS22GB1ATD1. Deleted by Rev. G.	B-7486514-P1
CR525# thru CR535#	Silicon rectifier, half wave; peak volts 400, capacitive load inverse 300, resistive load 500 ma. Similar to Westinghouse 1N1169. Added by Rev. G.	B-5490415-P2
CR538# thru CR541#	Silicon rectifier, half wave; peak volts 400, capacitive loan inverse 300, resistive load 500 ma. Similar to Westinghouse 1N1169. Added by Rev. G.	B-5490415-P2
CR542# and CR543#	Silicon rectifier, half wave peak volts 400, capacitive load inverse 300, resistive load 500 ma. Similar to Westinghouse 1N1169. Added by Rev. H.	B-5490415-P2
	FUSES	
F501	1/8 amp, 250 v, Type 3AG, quick to med blowing. Littelfuse Cat. #312.125, Bussman Cat. #AGC-1/8.	K-1R16-P12
F503	3 amp, 250 v, quick to med blowing, Littelfuse Cat. #312003. Bussman Cat. #AGC3.	K-1R16-P6
	JACKS AND RECEPTACLES	
J502	Part of W501.	
J503 and J504	Part of W501. (Green goes to Receiver, red to Transmitter.)	
J505#	Deleted by Rev. C.	
J507#	Deleted by Rev. C.	
J508#	Deleted by Rev. C.	
J509	Chassis, connector, 4 female contacts. Amphenol Type 91-PC4F.	K-7117934-P2
J518# thru J521#	Jack, metering; 4-pin, molded phenolic. Similar to Cinch Part #9800 except contact elements made for 0.080-inch pins. Added by Rev. C.	A-7160854-P1
	RELAYS	
K501	Coil operating range 4.9 to 6.9 v d-c, resistance 50 ohms ± 10%, at 25°C. spdt contacts.	K-7127542-P2
K506	7.2 v d-c operating, pickup 4.5 v d-c or less, resistance 28 ohms ± 10%, 1 form A, 3 form C contacts, contact pressure 25 grams min. Potter Brumfield Cat. #MJ-1195.	C-7774180-P6
	INDUCTOR	
L506#	Reactor: inductance 1.5 h at 0.085 amps d-c, d-c resistance 150 ohms max, peak a-c ripple 10 v RMS at 60 cycle, d-c operating 200 v. Added by Rev. A.	B-7489398-P1
	RESISTORS	
R509	Composition, 220 ohms ± 10%, 1 w.	C-3R78-P221K
R510# and R511#	Composition, 0.15 megohm ± 5%, 1/2 w. Changed by Rev. J.	C-3R77-P154J
R512	Composition, 1500 ohms ± 5% 1/2 w.	C-3R77-P152J
R513	Composition, 0.15 megohm ± 5%, 1/2 w.	C-3R77-P154J
R514	Composition, 1500 ohms ± 5%, 1/2 w.	C-3R77-P152J
R518	Composition, 22,000 ohms ± 10%, 1 w.	C-3R78-P223K
R519	Composition, 0.27 megohm ± 10%, 1/2 w.	C-3R77-P274K
R530	Composition, 0.10 megohm ± 10%, 1/2 w.	C-3R77-P104K
R540#	Deleted by Rev. A.	
R541	Wirewound, wire leads, 200 ohms ± 10%, 5 w.	B-7487415-P21
R542#	Deleted by Rev. A.	
R565#	Composition: 47 ohms ± 10%, 1/2 w. Added by Rev. A.	C-3R77-P470K
R572#	Composition, 470 ohms ± 10%, 1/2 w. Added by Rev. G. Deleted by Rev K	C-3R77-P471K
R574 and R575	Composition, 56,000 ohms ± 10%, 2 w.	C-3R79-P563K
R595#	Composition, 10 ohms ± 10%, 2 w. Added by Rev.G.	C-3R79-P100K
R601# and R602#	Composition, 150K ± 5% 1 w. Added by Rev. J.	C-3R78-P154J
R604#	Composition, 47 ohms ± 10%, 1/2 w. Added by Rev. K	C-3R77-P470K
	SWITCHES	
S501	Push-button type, momentary contact, sp NO., red button, 1/2 amp at 115 v a-c. Grayhill Cat. #4001.	M-7481654-P1
	TRANSFORMERS	
T507	Filament and rectifier, single phase. Pri: 115 v, 60 cycles: sec #1: 170/350 v, 0.325 amp; sec #2: 8.0 v, 1.5 amp; sec #3: 18.0 v, 0.015 amp; sec #4: 6.3 v, 8.0 amp.	B-7489097-P1
	CABLE	
W501#	Cable assembly: includes 30-conductor #22 AWG stranded, spiral shielded, nylon-jacketed cable, one 21-pin male plug, HB Jones Cat. #P-321-SB; two 11-contact female plugs. Cinch Cat. #13783 with metal caps or molded connectors with 11 female contacts. Component Mfg. Service Cat. #160-F11. Changed by Rev. B.	C-7775913-P2
	SOCKETS	
XF501 and XF503	Fuse holder. Bussman Type HKP	K-7115179-P1

PARTS LIST

CONTROL UNIT FRONT MOUNT

MODEL 4EC29A1,11,2,12

Symbol	Description	G-E Dwg. & Part Number
	INDICATING DEVICES	
I701 and I702	Lamp, incandescent miniature bayonet base, long bulb. 6.3 v, 0.15 amp at 6.8 v. G-E Cat. No. 47.	
	JACKS AND RECEPTACLES	
J701	Chassis, connector: 4 female contacts. Amphenol Type 91-PC4F.	K-7117934-P2
	LOUDSPEAKERS	
LS701	Speaker, permanent magnet, 3-1/2" voice coil impedance 3.2 ohm ± 10%, cone resonance 200 to 325 cps, 2 w.	B-7487536-P1
	PLUGS	
P701	21 female contacts HB Jones Cat. #S-321.	A-7144137-P1
P702	4-pin male cable clamp in top, with latches. HB Jones Cat. No. P-304-CCT-L. (Part of PL-7145244-G1)	B-7488601-P1

Symbol	Description	G-E Dwg. & Part Number
	RESISTORS	
R701	Composition, 2200 ohms ± 10%, 1/2 w.	C-3R77-P222K
R702	Potentiometer, composition, for push on knob; 15,000 ohms ± 20% linear taper, at 50% rotation 2 w, at 25% rotation 1.3 w. Allen Bradley Mfg. Co. Type J.	B-5490032-P1
R703	Potentiometer, composition, for push on knob; 250,000 ohms ± 20%, modified log taper.	B-5490032-P3
	SWITCHES	
S701	Toggle type, dpst, 1 amp at 250 v. 3 amp at 125 v. Arrow Hart and Hegeman Type 20902BJC. Used in 4EC29A1 only.	M-7478623-P2
S702	Toggle type, spdt, 1 amp at 250 v, 3 amp at 125 v, non-inductive. Arrow Hart and Hegeman Type #21350-BJC. Used in 4EC29A2,11,12 only.	M-7478623-P3
S703	Toggle type, dpst, 1 amp at 250 v, 3 amp at 125 v, non-inductive. Arrow Hart and Hegeman Type #20902-BJC. Used in 4EC29A11,12 only.	M-7478623-P2
	SOCKETS	
XI701	Indicator, light, miniature jewel, green lens.	A-7144663-P2
XI702	Indicator, light, miniature jewel, red lens.	A-7144663-P1

Symbol	Description	G-E Dwg. & Part Number
	MISCELLANEOUS PARTS	
	(2) Knobs: control, Butyrate (Tenite II) color red. Eastman Chemical Co. Cat. No. 28739.	B-7948315-P4
	Power Control Cable Assembly Includes the following: Cable: 3-conductor, tinned No. 8 awg 0.330 OD x 4 ft. ± 2.00 in. long. General Cable Corp Type S-JO. Connector: (P702)	PL-7145244-G1

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GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.

PARTS LIST

EXTENDED-LOCAL CONTROL UNIT

MODEL 4EC31A1

Symbol	Description	G-E Drawing
	Base: cast aluminum, blue and Metalustre finish.	D-7669294-P1
	Power cable assembly, includes cord set 6 feet long, flameol, #18 awg, tinning, rip cord 0.12 x 0.21. Molded plastic plug at one end. G-E Cat. #2071-1 and connector J702 on the other end, Ripcord U.L. Type SPT-1.	A-7145251-G1
	Front mount control unit; includes the following components.	4EC29A1
I701 and I702	Lamps; 6.3 v, 0.15 amp, miniature bayonet base. G-E Cat. #47.	
J701	Chassis connector: 4 female contacts. Amphenol Type 91-PC4F	K-7117934-P2
J702	Connector; 4 female contacts, cable clamp in top, with keepers. HB Jones Cat. #S-304-CCT-K.	B-7488601-P2
LS701	Speaker; 3-1/2 inch, permanent magnet, voice coil impedance 3.2 ohms ± 10%, cone resonance 200 to 325 cps.	B-7487536-P1
P701	Connector; 31 female contacts. HB Jones Cat. #S-321.	A-7144137-P1
P702	Connector; 4 pin male, cable clamp in top with latches. HB Jones Cat. #P304-CCT-L. Part of power control cable.	B-7488601-P1

Symbol	Description	G-E Drawing
R701	Resistor; composition, 2200 ohms ± 10%, 1/2 w.	C-3R77-P222K
R702	Potentiometer, composition, for push on knob; 15,000 ohms ± 20%, linear taper at 50% rotation 2 w, at 25% rotation 1.3 w.	B-5490032-P1
R703	Potentiometer; composition, for push on knob; 250,000 ohms ± 20%, mod log taper.	B-5490032-P3
S701	Switch: toggle type, dpst, 1 amp at 250 v, 3 amp at 125 v, non-inductive. Arrow Hart and Hegeman Type 20902-BJC.	M-7478623-P2
XI701	Socket: indicator light, miniature jewel, green lens.	A-7144663-P2
XI702	Socket: indicator light, miniature jewel, red lens.	A-7144663-P1
	Cable, power control; assembly includes cable 14 inches ± 1.00 inches long, 3 conductor, tinned, #18 Awg. and connector P702.	A-7145244-G1
	Knobs: color red. Eastman Chemical Co. Cat. #28739.	B-7948315-P4

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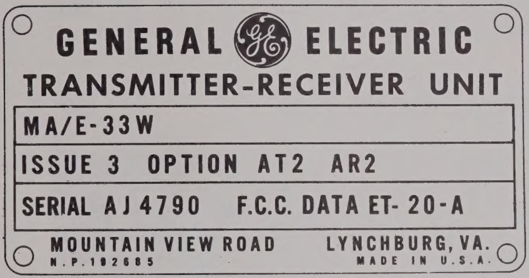
GENERAL INFORMATION

The following information has been included to assist the customer and serviceman in the use of this instruction book.

NAMEPLATE INFORMATION

General Electric Radio Communication Equipment is identified by a nameplate attached to the case or chassis of the unit. Typical nameplates currently in use are shown in Fig. 1 and Fig. 2.


GENERAL ELECTRIC
TRANSMITTER-RECEIVER UNIT
MA/E-33W
ISSUE 3 OPTION AT2 AR2
SERIAL AJ4790 F.C.C. DATA ET-20-A
MOUNTAIN VIEW ROAD
N.P.192685
LYNCHBURG, VA.
MADE IN U.S.A.

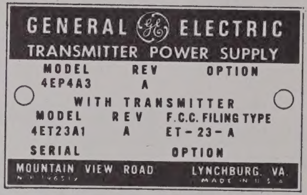

GENERAL ELECTRIC
TRANSMITTER POWER SUPPLY
MODEL
4EP4A3
REV
A
OPTION
WITH TRANSMITTER
MODEL
4ET23A1
REV
A
F.C.C. FILING TYPE
ET-23-A
SERIAL
OPTION
MOUNTAIN VIEW ROAD
LYNCHBURG, VA.
MADE IN U.S.A.

Fig. 1 Mobile Transmitter-Receiver Nameplate

Fig. 2 Station Transmitter Nameplate

"TYPE" numbers (such as Transmitter Type ET-20-A in Fig. 1) describe general classes of equipment and are used only for broad identification and, in the case of transmitters, for FCC filing.

"MODEL" numbers (such as Power Supply Model 4EP4A3 and Transmitter Model 4ET23A1 in Fig. 2) describe units in more detail than their type numbers and are essential for proper identification.

The "REV" letter indicates what production changes have been made on the unit. When the unit has a nameplate, the revision letter is stamped on the nameplate. Otherwise, the revision letter follows the model number stamped on the chassis of the unit.

The "OPTION" pad on the nameplate is stamped with one or more letters indicating the optional modifications that have been added to the equipment. The AT2 and AR2 stamped in the "OPTION" pad in the nameplate in Fig. 1, for example, indicates that the transmitter and receiver have been modified for two-frequency operation.

When writing for service parts, service information, etc. for a particular unit, the customer should give the model number, revision letter and option letters of the unit, as indicated in the following example:

Transmitter: Model 4ET21A2, Rev. A, Option none

The "COMBINATION" number (such as "MA/E-33W" in Fig. 1) describes the complete mobile or station combination. The "ISSUE" number indicates what models of equipment are in the combination. A new issue number is used each time one or more of the units in the combination changes model number. The "SERIAL" numbers are provided for the convenience of the customer in identifying his transmitters.

PRODUCTION CHANGES

From time to time, changes are made to the production equipment described in this book, either to improve performance or to simplify circuits. Any change made on a production unit will be assigned a Revision Letter, which will be stamped after the model number of the unit on the nameplate or on the chassis. A Revision Letter system is used as a means of identifying equipment and recording the changes made. Any given revision will always include all previous revisions.

A Production Change Sheet is located at the front of the section of the instruction book covering a unit that has been revised. This sheet lists the changes in the instruction book necessitated by each revision made on the unit. The Production Change Sheets should be used for checking and/or correcting instructional material to correspond with the revision/s of the equipment being serviced.

SERVICE PARTS

A list of all principal service parts for each unit of this equipment is included in the section of the book covering the unit. The symbol numbers used are the same as those appearing on the elementary diagram and other drawings.

Service parts may be obtained from authorized G-E Service Stations or ordered through any G-E Communications Equipment District Sales Office (see list of sales offices on last page). When ordering a part, please include the symbol number, description, and drawing number of the part and the model number and revision letter stamped on the unit.

SAFETY NOTICE

Since the use of high voltages is necessary for the successful operation of the radio equipment described in this instruction book, certain reasonable precautions must be carefully observed by the operating personnel during the installation, operation and maintenance of the equipment.

Although every practicable safety measure has been incorporated in this equipment, the following rule must be strictly observed:

WARNING

Under no circumstances should any person be permitted to handle any portion of the equipment that is supplied with high voltage, or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

FCC COMPLIANCE OF TRANSMITTER

In order to provide guaranteed performance, radio transmitters are usually designed with maximum performance characteristics which exceed somewhat the nominal ratings of the unit. The user should be certain to adjust the equipment in accordance with the rules and regulations of the radio transmission regulatory body to which he is subject. These rules usually include, for any particular service, the following:

1. Maximum power input to the final RF stage: Calculate the power input in watts by multiplying the plate voltage on the PA tube by the plate current in amperes. If the plate current cannot be measured directly and the cathode current is used instead, grid currents may be subtracted from the cathode current to

obtain the plate current. In most cases, the screen grid current cannot be metered conveniently, but can be calculated by dividing the voltage across the screen resistor by the resistance of the screen resistor. If maximum power output, rather than power input, for the final RF stage is to be measured, use a wattmeter to measure the power.

2. Maximum modulation: While monitoring the transmitter output with a modulation monitor, set the modulation control for maximum allowable deviation while the audio limiters in the transmitter have a saturating signal.

3. Frequency check: Measure the frequency of the unmodulated carrier at the required intervals and, if necessary, set the transmitter back on frequency.

The other characteristics of the transmitter which are not adjustable have been designed to comply with the rules and regulations of the principal radio transmission regulatory bodies in effect at the time of manufacture. Listings of G-E Equipment approved for use in various services can usually be obtained through the regulatory body, as well as information on current regulations which may come into effect after the initial equipment licensing.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the nearest General Electric Company District Sales Office.

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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COMMUNICATION PRODUCTS DEPARTMENT
DISTRICT SALES OFFICES

Requests for Service information and orders for replacement parts not obtainable from a local radio dealer may be directed to the nearest office listed below or to the General Electric Company, Communication Products Department, Carroll Avenue, Lynchburg, Virginia (Att: Service Parts Dept.).

ALABAMA		
BIRMINGHAM 9,	211-A, Benson Bldg., 1824-29th Ave., South	TRemont 9-9052
ARIZONA		
PHOENIX	Suite 619, Guaranty Bank Bldg. 3550 North Central Avenue	ALpine 8-6721
ARKANSAS		
LITTLE ROCK	5819 Kavanaugh	MOhawk 3-0810
CALIFORNIA		
LOS ANGELES 24,	1722 Westwood Boulevard	BRadshaw 2-0948, GRanite 3-0928
REDWOOD CITY	565 Broadway	EMerson 8-4681
SAN RAFAEL	2052 - 4th Street	GL-enwood 6-2366
COLORADO		
DENVER 11,	3775 Grove Street	GEnesee 3-6391
CONNECTICUT		
HARTFORD 3,	410 Asylum Street	JAckson 7-0135 7-0136
DISTRICT OF COLUMBIA		
WASHINGTON	927 Wyatt Building 777 - 14th Street, N.W.	EXecutive 3-3600
FLORIDA		
MIAMI	Grant Bldg., 203 S.W. 13th Street	FR 9-3339
TALLAHASSEE	Suite 201, Petroleum Bldg. Bronough & Pensacola Streets	4-5434
TAMPA	420 West LaFayette Street, Rm. 222	8-1918
GEORGIA		
ATLANTA 5,	3272 Peachtree Street, N.E., Room 12	CEdar 3-5493
ILLINOIS		
GLENVIEW	600 Waukegan Road	PArk 4-8633
INDIANA		
INDIANAPOLIS 8,	3750 North Meridian, Room 107	WAlnut 5-9633
KANSAS		
SHAWNEE MISSION	3628 West 95th Street	MItchell 9-7131
LOUISIANA		
METAIRIE	3305 Metairie Rd., P.O.Box 605	VErdon 5-5792
MARYLAND		
BALTIMORE 4,	762-C Fairmount Ave., Towson Plaza	VA-5-4900
MASSACHUSETTS		
WELLESLEY 81,	471 Washington Street	CEdar 5-4654, CEdar 5-5104
MICHIGAN		
FLINT	G-E Communications Center, G-5620 So. Saginaw	CEdar 2-2161
LANSING	Bank of Lansing Bldg., Room 1107	IVanhoe 2-4827
SOUTHFIELD	Imperial Office Plaza 17220 West 8-Mile Road	KE-4-5003
MINNESOTA		
MINNEAPOLIS 26,	3280 Gorham Avenue South	WEst 9-4622
MISSOURI		
ST. LOUIS 22,	10069 Manchester Road	YOrktown 6-3330 6-2220
MONTANA		
BILLINGS	325 Mobile Oil Building	ALpine 2-6329
NEBRASKA		
LINCOLN	1304 Stillwater Ave.	HEmlock 2-1936
NEW MEXICO		
ALBUQUERQUE	Suite 101, Fox Bldg., 120 Madeira, N.E.	265-0732
NEW YORK		
ALBANY	1593-H Central Avenue	UNion 9-6851
LIVERPOOL	Charles Annex, 914 Old Liverpool Rd.	OLdfield 2-2531, OLdfield 2-2532
NEW ROCHELLE	271 North Avenue, Room 819	3-7012
NORTH CAROLINA		
CHARLOTTE	Builders Bldg., Room 116 314 West Trade Street	FRanklin 5-5244
RALEIGH	900 Wade Avenue, Room 110	
NORTH DAKOTA		
BISMARCK	1st Federal Savings & Loan Bldg., Room 20 410 1/2 Thayer Ave.	CApitol 3-8111
OHIO		
CINCINNATI 30,	1514 Robinway Drive, P.O.Box 1536	BEachmont 1-1050
CLEVELAND 16,	20174 Center Ridge Road	EDison 1-8851
COLUMBUS 14,	4292 Indianola Avenue	AMherst 7-5473
OKLAHOMA		
OKLAHOMA CITY	6715 North May Avenue	VIctor 2-4421
OREGON		
PORTLAND	2929 N.W. 29th Avenue	CApitol 8-0281
PENNSYLVANIA		
ORELAND	114 Montgomery Avenue	WAverly 7-4939
PITTSBURGH 35,	3600 Laketon Avenue	CHurchill 2-6306
SOUTH CAROLINA		
COLUMBIA	3202 Devine Street, P.O.Box 5435	ALpine 2-5437
TENNESSEE		
NASHVILLE	107 Kennon Building, 745 Berry Road	CYpress 2-4604
TEXAS		
DALLAS 5,	4447 No. Central Expressway	LAkeside 6-0426
EL PASO	P.O.Box 3272, Station A	PRospect 2-1035
HOUSTON 25,	Park Towers Bldg., Suite 224 1700 East Holcombe Boulevard	JAckson 8-1269
MIDLAND	228-229 Wilkerson-Foster Bldg., P.O.Box 1567	MUtual 2-9257
SAN ANTONIO	109 Lexington Avenue	CApitol 4-7151
UTAH		
SALT LAKE CITY	2518 South State Street	HUnter 4-5203
VIRGINIA		
RICHMOND 26,	5405 Patterson Avenue	ATlantic 8-1935, ATlantic 8-1936
ROANOKE	3728 Williamson Road, N.W.	EMpire 6-8063
WASHINGTON		
SEATTLE 4,	2 Hanford Street	MAin 2-7661
SPOKANE 4,	South 162 Post Street	TEmple 8-3621
WISCONSIN		
MENOMONEE FALLS	P.O.Box 392	1-0600

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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INSTALLATION INSTRUCTIONS FOR TWO-FREQUENCY MODIFICATION KIT PL-7146329-G1
(for Control Unit EC-27-A, EC-29-A and EC-31-A)

If Control Unit EC-27-A, EC-29-A, or EC-31-A is to be used with a two-frequency transmitter and/or a two-frequency receiver, the control unit must be modified by the addition of Modification Kit PL-7146329-G1. This kit adds a channel-selector switch to the control unit for changing the operating frequency. The original nameplate on control Unit EC-29-A or EC-31-A must be replaced with the appropriate nameplate listed below:

Original Nameplate	NP-177272
Single-Option Nameplate	NP-177273
Two-Option Nameplate	NP-177274

If only one modification kit is being added to the control unit, use the Single-Option Nameplate, but if two are being used, use the Two-Option Nameplate.

To make the modification, follow the directions on Sheets 1, 2 and 3 of Installation Diagram A-7150175, which accompanies these instructions.

PARTS LIST

Switch assembly:		A-7144010-G1
	includes	
S1	Toggle switch: spdt, 1 amp at 250 v, 3 amp at 125 v, non-inductive. Arrow Hart and Hegeman Type 21350-BJC.	M-7478623-P3

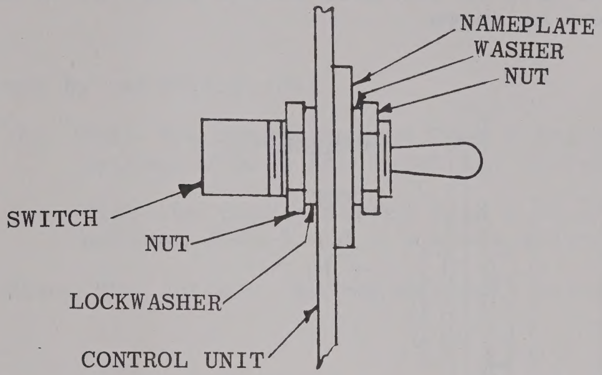
COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

This kit may be used on either the EC-27-A or the EC-29-A control units as follows:

EC-27-A

1. Remove the plug button from the control unit (alongside mic jack).
2. Mount the kit switch (S) in the hole which contained the plug button using hardware provided as shown:

NOTE: (If another control unit option has been specified, this switch may be mounted in the two option nameplate in the hole marked channel A/B, and the nameplate NP196462 discarded).

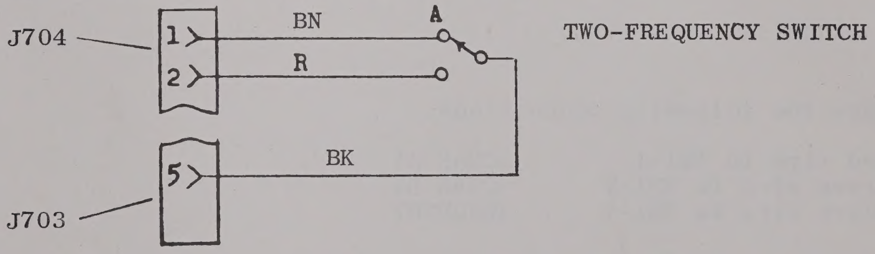

NAMEPLATE
WASHER
NUT
SWITCH
NUT
LOCKWASHER
CONTROL UNIT

(SIDE VIEW)

3. Make the following connections

   Red wire to J704-2
   Brown wire to J704-1
   Black wire to J703-5

4. The circuit will now be as follows:


J704
1
2
BN
R
A
TWO-FREQUENCY SWITCH
5
BK
J703

Installation Diagram - Sheet 1

TWO-FREQUENCY MODIFICATION
KIT PL-7146329-G1

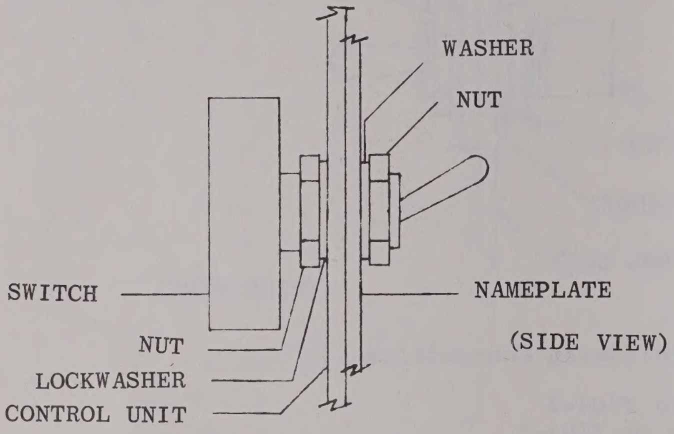
(A-7150175, Rev. 3)

6. Test by observing that with the toggle towards Chan. A, there is continuity between J704-1 and J703-5 but not between J704-2 and J703-5. Also with the toggle toward CHAN. B, there is continuity between J704-2 and J703-5 but not between J704-1 and J703-5.
7. Stamp the letter "A2" after the model number.

EC-29-A

1. Remove the normal nameplate.
2. Replace with single option (or two option) nameplate. (See application index 7489200 or 7489211 for reference).
3. Mount POWER-OFF switch in the hole between the two pilot lights.

4. Mount the kit switch (S1) in the hole marked CHAN. A, B, using the hardware provided as shown.



5. Make the following connections:

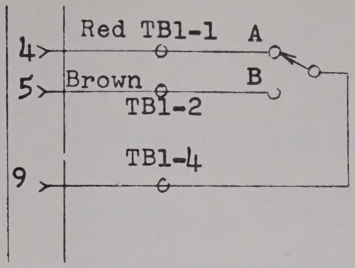
Red wire to TB1-1	(CHAN A)
Brown wire to TB1-2	(CHAN B)
Black wire to TB1-4	(GROUND)

Installation Diagram - Sheet 2

TWO-FREQUENCY MODIFICATION
KIT PL-7146329-G1

(A-7150175, Rev. 3)

6. The circuit will now be as follows:



TWO-FREQUENCY SWITCH

7. Test by observing that:

   (a) With the toggle toward CHAN A there is continuity between J701-4 and 9 but not between J701-5 and 9.

   (b) With the toggle toward CHAN B there is continuity between J701-5 and 9 but not between J701-4 and 9.

8. Stamp the letters "A2" on the unit after the model number.

DESCRIPTION AND MAINTENANCE INSTRUCTIONS
FOR
TRANSMITTER MODELS
4ET20A1, 2, 11 & 12 AND 4ET21A1, 2, 11 & 12

General Electric Transmitter Models 4ET20A1, 2, 11 & 12 and 4ET21A1, 2, 11 & 12 are Progress Line Units designed for operation on fixed frequencies within the 144-174 megacycle band. Both single-frequency and two frequency units are available. Three-frequency and four-frequency operation is possible by using external oscillators. Through the use of plug and cable connections, each transmitter has been made readily interchangeable between mobile and fixed stations. A screwdriver is the only tool needed to make the change. The following chart shows the power output and frequency range of each transmitter model.

	144-152 Megacycles		152-174 Megacycles	
	Single-Freq.	Two-Freq.	Single-Freq.	Two-Freq.
10/25 Watts Nominal Power Output	4ET20A1	4ET20A11	4ET20A2	4ET20A12
50 Watts Nominal Power Output	4ET21A1	4ET21A11	4ET21A2	4ET21A12

These crystal-controlled, phase-modulated transmitters employ a total of eight tubes (ET-20-A) or nine tubes (ET-21-A), two of which comprise the audio section and the remainder the RF section. The two-frequency transmitters employ an additional tube as the Channel B oscillator. By using external oscillators, three and four-frequency operation is also possible. The transmitter's quartz crystal carries a LIFETIME GUARANTEE.

The transmitter has been designed for maximum accessibility of tuning controls and components. All tubes and tuning controls are accessible from the top of the chassis, but no voltages are exposed above the chassis. All power and control connections to the transmitter are made through an 11-pin plug and cable (W101) to the power supply.

An RF indicator (I101) is included on the transmitter chassis to indicate the presence of RF voltage on the antenna lead. It may also be used as an auxiliary means of tuning the PA and its drive and the antenna circuit for maximum power to the antenna. Servicing is further simplified by using the Indicator to locate such faults as an open antenna circuit.

FIVE-STAR TUBES

The tubes employed in the transmitter are widely-accepted, highly efficient, long-life tubes which meet the requirements of the majority of installation. In certain installations, where the tubes will be subject to severe shock and vibration, it may prove more economical to employ General Electric "Five-Star Tubes". These tubes are more ruggedly constructed, must pass more rigid tests, and are carefully "aged" to eliminate early failures. This results in increased life, particularly under the severe vibration conditions sometimes encountered in mobile installations. The Five-Star Tubes which are available for use in this transmitter are listed below.

Prototype Tube	Five-Star Tube
6661/6BH6	GL-6265
6680/12AU7	GL-5814-A

For 6-volt operation, no modification is necessary on the transmitter after adding Five-Star Tubes. Since the Five-Star replacements for the 6BH6 and 12AU7 tubes draw slightly more filament current than their prototypes, heater unbalance will be experienced on 12-volt operation unless a balancing resistor is added in the filament circuit. Directions for making this modification on each transmitter model are given below.

Models 4ET20A1 or 2 - Add a 120-ohm ± 10%, 1-watt balancing resistor between pin 9 on tube socket XV109 and ground.

Models 4ET20A11 or 12 - Remove resistor R200 (39-ohm, 2 watt) from between pins 4-5 and pin 9 on XV109. Add a 51-ohm ± 10%, 2-watt balancing resistor between pins 5 and 9 on XV109.

Models 4ET21A1 or 2 - Add a 51-ohm ± 10%, 2-watt balancing resistor between pins 4-5 and 9 on tube socket XV109.

Models 4ET21A11 or 12 - Remove resistor R200 (39-ohm, 2-watt) from between pins 4, 5 and pin 9 on tube socket XV109. Add a 200-ohm ± 10%, 1/2-watt balancing resistor between pin 9 on tube socket XV109 and ground.

MAINTENANCE

To prevent undue interruption of the proper operation of the equipment, regular preventive maintenance procedures should be followed. This preventive maintenance should include the following.

1. A check of the operating frequency as required by the Federal Communications Commission.

2. Comparison of voltages read at the metering jacks with those given on back of SERVICE OUTLINE for the transmitter.

3. A check of the power amplifier tank tuning and re-alignment if improper operation is indicated.

4. Inspection for loose screws and nuts and broken cables and wires caused by shock or vibration in mobile units.

5. Measurement of the B-plus voltage on the transmitter power supply chassis.

6. Preventive maintenance on the battery, generator and voltage regulator when installed in a vehicle.

7. Cleaning of relay contacts if necessary.

CIRCUIT ANALYSIS

Transmitters ET-20-A and ET-21-A are crystal-controlled, phase-modulated transmitters having a nominal power output of 10/25 watts (ET-20-A) or 50 watts (ET-21-A). The crystals used fall in the range from 6.000 to 7.250 megacycles. The multiplier stages multiply the crystal frequency 24 times.

CRYSTAL OSCILLATOR

Keying the transmitter applies B-plus voltage to the crystal-oscillator, V101 (6BH6). The oscillator is of the electron-coupled type and uses a capacitive voltage divider feedback network consisting of C106 and the input capacitance of V101 to maintain oscillation. Heated ovens are available for maintaining the crystal temperature at 100°C (212°F), stabilizing the frequency against drift due to temperature change. In the single-frequency transmitter, the cathode circuit of V101 is continuously grounded by the jumper from TB-2-1 to ground. This jumper is not present in the two-frequency transmitter, and a second oscillator stage, V201 (6BH6), is used for operation on Channel B. The desired oscillator section can oscillate only when its cathode circuit is grounded by the Channel-Selector Switch on the control unit.

In two-frequency operation, the frequencies of the two channels should not be more than 0.65 megacycles apart. Since the transmitter has a crystal multiplication of 24, the crystal frequencies should not be more than 28 kilocycles apart. In installations in which slight de-rating of the transmitter output is permissible, greater frequency spreads may be used.

AUDIO AMPLIFIER

The audio signal entering the transmitter at P101-2 is applied to the audio amplifier, V110 (12AU7), and undergoes two stages of amplification. C173 and C179 are RF by-pass capacitors. From the audio amplifier, the signal passes to the modulation limiter, V109 (12AU7).

LIMITER AND MODULATOR

The phase modulator produces a peak frequency deviation proportional to both the peak voltage and the frequency of the audio signal applied. To limit the peak deviation to a given value, the product of the peak voltage and the frequency of the audio signal must not exceed some given figure. V109 is a voltage limiter which fixes the maximum peak voltage applied to the input of the de-emphasis network R196, R197, R198, R199, C191, C192, C193, C184. The de-emphasis network acts in such a way that, with a given voltage applied to its input, the output voltage across C184 is inversely proportional to its frequency (i.e., the higher the frequency, the lower the output voltage in direct proportion). Thus at the output of the de-emphasis network, the product of the peak voltage and its frequency can never exceed a certain value over the range of voice frequencies and the levels encountered in use. Since this constitutes the audio signal applied to the phase modulator, the peak deviation is limited to a value determined by circuit adjustment.

If the audio input to the transmitter is not great enough to cause limiting in V109, the limiter acts as a simple audio amplifier. In order to eliminate the effect of the de-emphasis network at these levels, the pre-emphasis network, C174 and R174, is included. For a fixed voltage applied across this network, the output voltage across R174 is directly proportional to its frequency. This action is the opposite of that of the de-emphasis network, so that, at audio levels below limiting, the two cancel and have no net effect upon the audio signal.

The RF output of the oscillator stage, which is developed across L108, is applied to the input of the phase modulator, the triode section of V102 (6U8). When an audio modulating voltage from the output of the de-emphasis network is also applied to the input of the modulator, the resulting modulator output is a phase-modulated RF signal (indirect FM), which is applied to the first multiplier, the pentode section of V102 (6U8). Potentiometer R186 controls the level of peak deviation.

MULTIPLIERS

The first multiplier is a frequency doubler, whose grid bias is self-developed across R115 and R117. The MULTI-1 metering jack is provided to observe proper operation of the oscillator and modulator stages. The tank circuit (Z101) is tuned to twice the crystal frequency by adjustment of the tuning slug in the coil (Z101-L1). The output of the first multiplier is capacitively coupled to the grid of the second multiplier through Z101-C1.

The second multiplier, V103 (6BH6), is a frequency tripler. Biasing is provided by R120 and R121. R121 is also used as MULT-2 metering resistor for tuning the first multiplier plate tank. The second multiplier plate tank (Z102) is tuned to six times the crystal frequency and is coupled to the third multiplier grid tank (Z103) by means of "low-side" capacitive coupling. A part of the RF voltage in the second multiplier plate circuit appears across C122 and C121 in parallel. Since C122 and C121 are also part of the third multiplier grid circuit, this RF voltage is coupled into the grid tank.

The third multiplier, V104 (6CL6), is a doubler. The MULT-3 jack is used in tuning the second multiplier plate tank coil (Z102) and the third multiplier grid tank coil (Z103). Z103-R1 and R128 are grid bias resistors. R127 is a grid loading resistor, used to prevent regeneration in the 6CL6 multiplier tube, which has a very high transconductance. The third multiplier plate tank (Z104) is tuned to twelve times the crystal frequency and is coupled to the fourth multiplier grid tank (Z105) by means of low-side capacitive coupling, in which C132 and C133 are the common coupling elements.

The fourth multiplier, V105 (2E26), is a doubler. Z105-R1 is its grid bias resistor and Z105-R2 and R135 comprise the metering network for the MULT-4 jack. The fourth multiplier plate tank circuit, L105 and C140, is tuned to 24 times the crystal frequency and is inductively coupled to the power amplifier grid tank coil (L106 or L118). The "printed-circuit" Faraday shield between the fourth multiplier plate coil and the PA grid coil eliminates capacitive coupling between the coils to reduce spurious radiation. In transmitter ET-21-A, the PA grid coil is broadly resonant and need not be adjusted unless the carrier frequency is greatly changed; therefore, no PA grid tuning control is provided. In transmitter ET-20-A, C154 is the PA GRID tuning control.

POWER AMPLIFIER

Transmitter Models 4ET20A1, 2, 11, and 12 employ a single 6146 power amplifier tube, V107, to obtain a nominal power output of 10/25 watts. Transmitter Models 4ET21A1, 2, 11 and 12 use two 6146 tubes, V107 and V108, in push-pull to obtain a nominal power output of 50 watts. The PA grid bias circuit in the ET-20-A is composed of R139, R140 and R141, with R139 also serving as the PA GRID metering resistor. In the ET-21-A, R146, R145 and R141 perform the same respective functions. Fixed bias is permanently applied to the grids of both the power amplifier and the fourth multiplier, as a protective measure. Consequently, there is a small residual meter reading at the MULT-4 jack and the PA GRID jack, even where no excitation is present. C149 and L110 (and C151 and L109 in transmitter ET-21-A) prevent self-oscillation of the power amplifier. A TUNE-OPERATE switch, S101, is provided to reduce the screen voltage on the 6146 power amplifier tube(s), protecting them from excessive plate current while the transmitter is being tuned.

The power amplifier plate tank coil is adjusted to approximately the correct frequency on transmitter ET-21-A by adjusting its shorting bar. C150 (on transmitter ET-21-A) or C157 (on transmitter ET-20-A) tunes the PA plate tank. The amount of inductive coupling between the plate tank coil and the antenna coil may be adjusted by means of the ANT COUPLING control, which varies the orientation of the antenna coil with respect to the PA plate tank coil. The ANT TUNING capacitor, C167 is used to tune out any reactance presented to the antenna circuit by an antenna feed cable having a standing-wave ratio greater than 1:1, a situation nearly always encountered in actual installations.

LOW-PASS FILTER, ANTENNA RELAY AND RF INDICATOR

Following the antenna coupling coil is a low-pass filter consisting of one constant-K and two M-derived full sections. Keying the transmitter energizes the antenna relay, K102, which switches the antenna from the receiver to the transmitter. The RF indicator, I101, is a neon-lamp used to indicate the presence of RF voltage on the antenna lead.

The RF low-pass filter incorporated in the design of the transmitter materially decreases spurious radiations. In systems where a transmitter and receiver, relatively close in distance and frequency operate simultaneously, it will be desirable to provide attenuation to prevent receiver desensitization. One solution would be to electrically replace the low-pass filter with a General Electric Cavity Filter Type KY-5-A. Removal of the low-pass filter is required to facilitate the determination of line lengths.

The cavity may be applied, with regard to the transmitter, in one of two manners depending upon the system and mode of operation. In simplex systems operating push-to-talk from the same antenna, Cavity Type KY-5-A may be installed in the antenna lead-in (transmission line) between the antenna and the antenna connector. In duplex systems, Cavity Type KY-5-A should be installed between the transmitter antenna coupling coil and the transmitter contact of the antenna-switching relay. When substituting a cavity for the low-pass filter, the cavity will provide as much or more attenuation to spurious radiation as the low pass filter.

When installing Cavity in Antenna lead-in to transmitter and receiver.

1. Remove the filter housing cover (smaller aluminum cover on underside of chassis) by depressing the spring clips and pulling housing out.
2. Unsolder lead to filter coming from antenna coupling coil.
3. Unsolder lead to filter coming from antenna switching relay (mounted adjacent to filter).
4. Remove components of filter.
5. Mount Winchester insulated stand-offs, or equivalent, using mounting holes formerly occupied by stand-off capacitors C161 and C166.
6. Terminate leads removed by steps 2 and 3 in stand-offs and solder a piece of wire between the two stand-offs.
7. Replace filter housing.
8. Connect cavity between antenna and antenna connector. Refer to cavity Instructions for Installation and Tuning Instruction.

When installing cavity between the transmitter antenna coupling coil and the transmitter contact of the Antenna Switching relay:

1. Follow steps 1 through 4 of above procedure.
2. Fashion a bracket to contain two Amphenol Type 83-1R receptacles for mounting in the space formerly occupied by the filter. The bracket illustrated and dimensioned below is suggested as ideal for Progress Line Receivers. Punch or saw two 3/4-inch holes in the top of the filter cover as illustrated below. Mount Type 83-1R receptacles to the bracket.

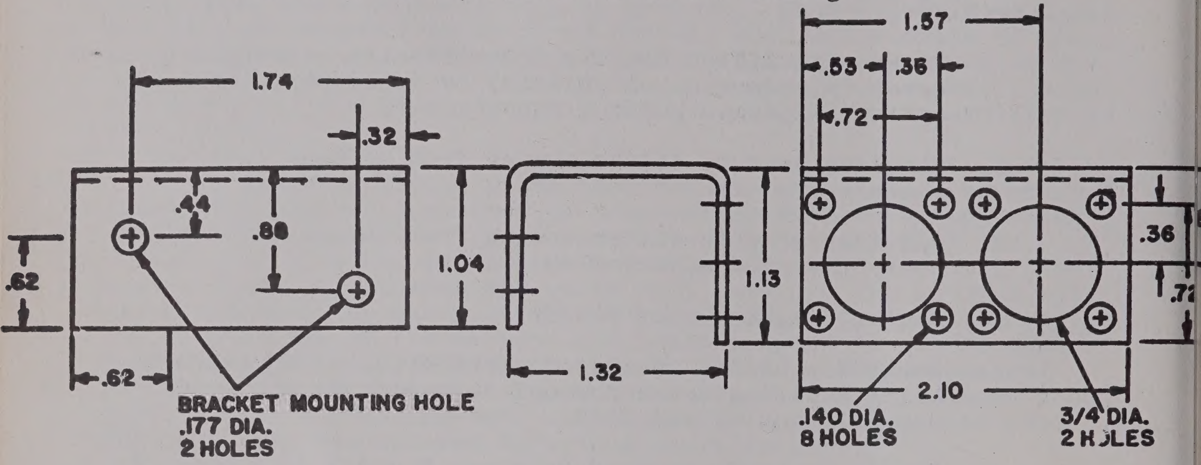
3. Mount the bracket to the transmitter chassis in the space formerly occupied by the low pass-filter, using the mounting holes already in the chassis.

4. Solder lead from antenna coupling coil to closest bracket receptacle. Solder lead from antenna switching relay to other bracket receptacle.

5. Re-mount filter housing cover.

6. Connect the cavity between the two receptacles on special mounting bracket and make antenna connections as for normal installation.

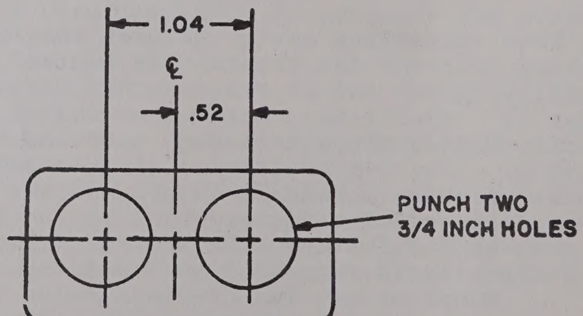
7. Refer to Cavity Instructions for tuning.


1.74
.32
.44
.88
.62
.62
BRACKET MOUNTING HOLE
.177 DIA.
2 HOLES
1.04
1.32
1.13
1.57
.53
.36
.72
.36
.72
2.10
.140 DIA.
8 HOLES
3/4 DIA.
2 HOLES

MATERIAL: COMMERCIAL QUALITY COLD ROLLED LOW CARBON SHEET STEEL .050 THICK, .03 BEND RADIUS.

FINISH: CADMIUM PLATE

SUGGESTED BRACKET FOR CAVITY APPLICATION


1.04
℄
.52
PUNCH TWO
3/4 INCH HOLES

TOP OF FILTER HOUSING

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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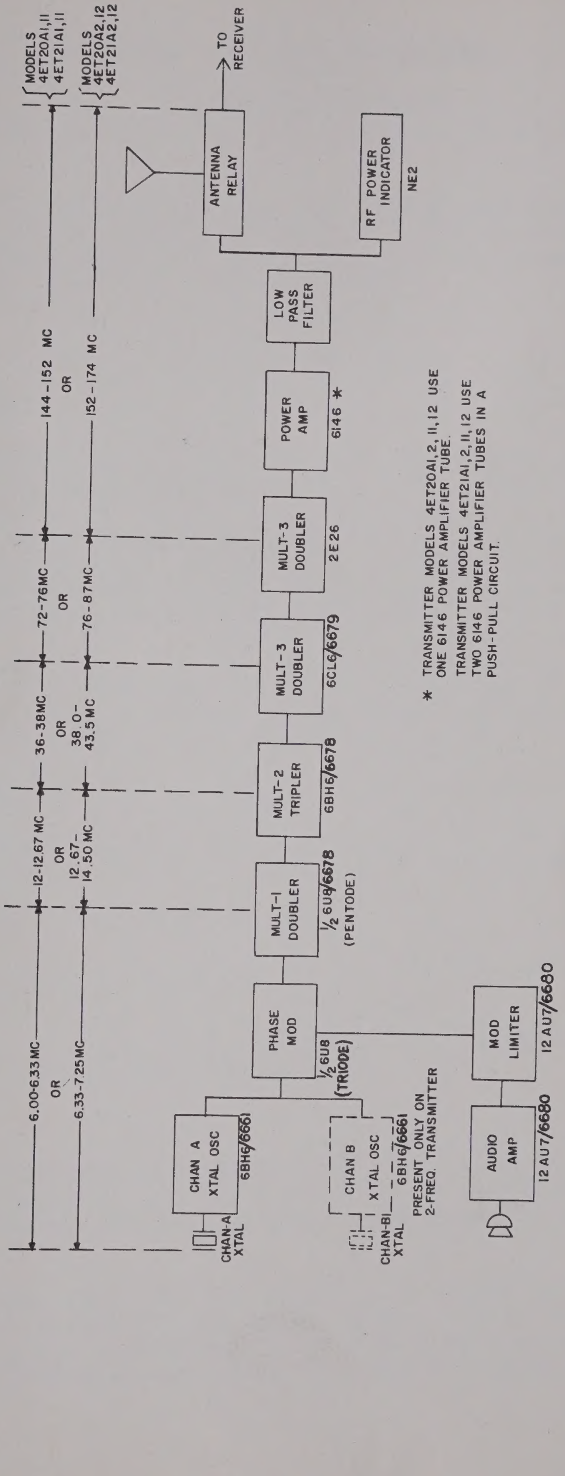
MODELS 4ET20A1,11 4ET21A1,11
MODELS 4ET20A2,12 4ET21A2,12
TO RECEIVER
ANTENNA RELAY
RF POWER INDICATOR
NE2
LOW PASS FILTER
144-152 MC
OR
152-174 MC
POWER AMP
6146 *
MULT-3 DOUBLER
2E26
72-76MC
OR
76-87MC
MULT-3 DOUBLER
6CL6/6679
36-38MC
OR
38.0-43.5 MC
MULT-2 TRIPLER
6BH6/6678
12-12.67 MC
OR
12.67-14.50 MC
MULT-1 DOUBLER
½ 6U8/6678
(PENTODE)
PHASE MOD
½ 6U8
(TRIODE)
6.00-6.33 MC
OR
6.33-7.25 MC
CHAN A XTAL OSC
6BH6/6661
CHAN-A XTAL
CHAN B XTAL OSC
6BH6/6661
CHAN-B1 XTAL
PRESENT ONLY ON 2-FREQ. TRANSMITTER
MOD LIMITER
12 AU7/6680
AUDIO AMP
12 AU7/6680
* TRANSMITTER MODELS 4ET20A1,2,11,12 USE ONE 6146 POWER AMPLIFIER TUBE.
TRANSMITTER MODELS 4ET21A1,2,11,12 USE TWO 6146 POWER AMPLIFIER TUBES IN A PUSH-PULL CIRCUIT.

Block Diagram

144-152 MC TRANSMITTER
MODELS 4ET20 & 21A1, 11
152-174 MC TRANSMITTER
MODELS 4ET20 & 21A2, 12

(RC-353A)

BENCH ALIGNMENT PROCEDURE
FOR
TRANSMITTER MODELS
4ET20A1, 2, 11 & 12 AND 4ET21A1, 2, 11 & 12

This Bench Alignment Procedure is provided for completely re-aligning Transmitter Models 4ET20A1, 2, 11 & 12 and 4ET21A1, 2, 11 & 12 or for changing their frequency. Instructions for adjusting the modulation level are also included.

ALIGNMENT PROCEDURE

TEST EQUIPMENT

The transmitter can be completely realigned, using a 20,000 ohm-per-volt voltmeter which covers the 0 to 3-volt range. The voltage indications given in the following alignment procedure are the values which should be read on such a meter. General Electric Test Set Type EX-1-C is an instrument designed for the many metering applications encountered when tuning Radio Communication and associated equipment and includes a 20,000 ohm-per-volt meter.

If a meter equivalent to the one suggested is not available for tuning purposes, others may be used, but the meter reading obtained must be corrected to account for the shunting effect of the different meter resistance on the metering circuit.

The following test equipment is recommended:

1. A 20,000 ohm-per-volt meter, such as the G-E Test Set Type EX-1-C, which covers the 0 to 3-volt range.

2. A non-metallic screwdriver.

3. A frequency measuring device, such as Lampkin Type 105B or Gertsch Model FM-3.

4. An absorption wavemeter which will tune to 2, 6, 12 and 24 times the crystal frequency.

PROCEDURE

Refer to SERVICE OUTLINE RC-344 (see Table of Contents) to locate the tuning controls referred to in the following alignment procedure. All meter readings are measured between the jack indicated and ground.

1. Be sure that the oscillator crystal(s) is (are) correctly connected between the points shown in the following table. The crystal frequency for each channel is 1/24th of the channel frequency. XY2101 and XY2102 are located on the Multi-Frequency Adapter.

Crystal	Single-Frequency and Two-Frequency Transmitters	Three-Frequency and Four-Frequency Transmitters
CHAN A	XY101-4 and 6	XY2101-4 and 6
CHAN B	XY101-2 and 8 (2-Freq. only)	XY2101-2 and 8
CHAN C		XY2102-4 and 6
CHAN D		XY2102-2 and 8 (4-Freq. only)

2. In multi-frequency transmitters, turn the Channel-Selector Switch on the Control Unit to CHAN A, if the greatest frequency separation between channels is less than 0.4% of the operating frequency. (Select the channel having the lowest frequency if CHAN A is not the lowest.) For frequency separations greater than 0.4%, a crystal having a frequency which is the average of the crystal frequencies for the highest and lowest channels should be used to align the transmitter.

3. Connect the antenna or another load to the transmitter.

4. Set the TUNE-OPERATE switch (S101 on the PA housing) on TUNE.

5. Rotate the ANT COUPLING control to its extreme clockwise position.

6. Turn the power on and allow 30 seconds for the transmitter to warm up to operating temperature.

7. A voltage reading of approximately 1.0 volts between the MULT-1 jack, J101 (green-negative), and ground when the transmitter is keyed indicates proper operation of the Oscillator and Modulator stages of the transmitter. Use the ground jack located on the power supply chassis.

8. With the meter lead moved to the MULT-2 jack, J102 (green-negative), key the transmitter and tune Z101 ("1") for maximum meter reading (approximately 1.6 volts).

CAUTION

Do not key the transmitter for longer than 30 seconds in each minute until the 4th Multiplier plate has been tuned.

9. Alternately tune Z102 ("2") and Z103 ("3") for maximum meter reading (approximately 1.8 volts) at the MULT-3 jack, J103 (green-negative).

When making a great change in frequency, it may not be possible to see any indication on the meter when Z102 is tuned, unless Z103 is tuned near the correct frequency. In this case, pretune Z102 by one of the following methods:

(a) With the 300-volt scale of a vacuum tube voltmeter or a 20,000 ohm-per-volt voltmeter connected at the screen of the 2nd Multiplier (pin 6 of XV103), tune Z102 ("2") for a slight dip in screen voltage.

(b) Hold an absorption wavemeter close to the bottom of Z102, and tune for resonance.

It is possible to tune Z102 and Z103 to the wrong harmonic of the crystal frequency. Z102 and Z103 will ordinarily be correctly tuned if their slugs are first screwed all the way out and then screwed in to the first indication of resonance. Check the tuning with a wavemeter.

10. Alternately peak Z104 ("4") and Z105 ("5") while metering at the MULT-4 jack. J104 (green-negative). Fixed bias on the MULT-4 grid will appear as a small initial reading (0.5-1.0 volt) at J104, whether or not Z104 and Z105 are correctly tuned. The meter should read approximately 1.6 volts for proper tuning.

A slight dip at J103 may be used as an indication of resonance of Z104 if both Z104 and Z105 are badly misaligned.

NOTE

In mobile installations, the transmitter must be either in its case or standing on a metal base plate while the MULT-4 PLATE control (and, in Transmitter Type ET-20-A, the PA GRID control) is being tuned. Otherwise, these controls will be detuned when the unit is returned to its case.

11. Peak the MULT-4 PLATE control (C140), while metering at the PA GRID jack, J105 (green-negative). In Transmitter ET-20-A, also peak the PA GRID tuning control (C154). Fixed bias on the PA grid will appear as a small initial reading at J105, whether or not the MULT-4 PLATE control is correctly tuned.

In the ET-21-A, L106, the PA grid tank coil (located in front of the "printed circuit" Faraday shield and between the PA tube sockets) may also need to be adjusted for maximum reading at the PA GRID jack, if making a great change in frequency.

WARNING

HIGH VOLTAGE is present under the transmitter chassis. Disconnect all power from the transmitter before proceeding.

For a transmitter operating between 165 and 174 megacycles, the turns should be spread as far apart as possible. The spacing between coils L105 and L106 should also be adjusted for maximum meter reading. At this point, with the transmitter operating on TUNE and the PA plate untuned, the meter should read at least:

152 MC - 2.8 volts
162 MC - 2.6 volts
174 MC - 2.2 volts

These are minimum readings and the operator should try to exceed them.

12. Repeak the MULT-4 PLATE and the PA GRID (ET-20-A) or L106 (ET-21).

13. ET-21-A only - DISCONNECT ALL POWER FROM THE TRANSMITTER. Remove the PA tuner shield and ground one of the PA tube plate caps with an insulated screwdriver. Adjust the PA plate shorting bar on L113 for the correct frequency. At 152 megacycles, the bar should be 1/8-inch above the bend in L113. At 174 megacycles, the bar should be about level with the lower end of the Textolite* shaft on the ANT COUPLING control. For other frequencies, adjust the bar proportionately between these extremes. Replace the PA shield.

14. Connect the meter leads between the CATH PA jack, J106 (red-positive), and ground, key the transmitter and tune the PA PLATE control (C150 or C157) for minimum meter reading.

15. Switch the TUNE-OPERATE switch to OPERATE, and quickly tune the MULT-4 PLATE (and, in the ET-20-A, the PA GRID) for minimum meter reading at the CATH PA jack.

16. Alternately tune the PA PLATE and ANT TUNING controls for minimum CATH PA current.

17. Tune the ANT TUNING control for maximum CATH PA current. If no peak is observed, rotate the ANT COUPLING control slightly counterclockwise and peak the ANT TUNING control.

18. Rotate the ANT COUPLING control counterclockwise until the CATH PA meter reads 1.4 volts (on 25 or 50-watt transmitters) or 1.0 volt (on 10-watt transmitters).

19. Repeak the ANT TUNING control.

20. ET-20-A - Adjust the ANT COUPLING control for CATH PA meter reading of 1.6 volts when used with a medium-power power supply (25 watts) or 1.1 volts when used with a city-power power supply (10 watts).**

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*Registered U.S. Patent Office.

**For FCC purposes, the plate current of the power amplifier stage may be accurately calculated in milliamperes by multiplying the reading at the CATH PA jack by the conversion factor as listed:

Type ET-20-A	1 volt = 100 milliamperes
Type ET-21-A	1 volt = 200 milliamperes

ET-21-A - Adjust the ANT COUPLING control for CATH PA meter reading of 1.5 volts.

21. Retune the MULT-4 PLATE control (C140) and the PA GRID control (ET-20-A) for maximum reading at the PA GRID jack, J105 (green-negative). The reading should be approximately 1.0-2.0 volts on transmitter ET-20-A or approximately 1.8-2.6 volts on transmitter ET-21-A.

22. Alternately repeat Step 19 and Step 20 until no further change in meter reading is obtained.

23. Check the frequency of the transmitter. In single-frequency and two-frequency transmitters adjust the FREQ ADJ A control if necessary, to set Channel A on frequency. In two-frequency transmitters, check Channel B also and set it on frequency by means of the FREQ ADJ B control. The frequency of three and four-frequency transmitters should also be checked and adjusted, if necessary, on the Multi-Frequency Adapter.

PA ALIGNMENT USING RF INDICATOR LAMP

The neon glow RF indicator, I101, located on the chassis near the PA housing, is intended to indicate only the presence or absence of RF power on the antenna lead. In an emergency however, when the power amplifier must be aligned and there is no other means at hand, I101 may be used as a tuning indicator. The transmitter must already be roughly aligned and the procedure below must be followed.

1. Set the TUNE-OPERATE switch on OPERATE and turn the ANT COUPLING control fully clockwise.

2. Key the transmitter, and alternately adjust the PA PLATE and the ANT TUNING controls for minimum brightness of I101. (If tuning the PA PLATE causes I101 to go out, set the PA PLATE at a point mid-way between the points at which I101 goes out.)

3. Adjust the ANT TUNING control for maximum brightness. (If no change is noticed, rotate the ANT COUPLING control slightly counterclockwise until an indication can be seen as the ANT TUNING control is adjusted.)

4. Rotate the ANT COUPLING for maximum brightness.

5. Tune the MULT-4 PLATE (and, in Transmitter Type ET-20-A, the PA GRID) for maximum brightness.

6. Readjust the ANT COUPLING and the ANT TUNING for maximum brightness.

The transmitter is now aligned and delivering maximum power to the load. However, since I101 gives no indication of the actual value of plate current being drawn, it is advisable to continue with the next step, to lessen the possibility of exceeding the PA tube ratings.

7. Back the ANT COUPLING off in a clockwise direction until a slight decrease in the brilliance of I101 is noted.

MODULATION LEVEL ADJUSTMENT

The modulation level control, R186, was adjusted to the proper setting before shipment and should not normally require re-adjustment. This setting permits approximately 60 percent modulation for the average voice level. The occasional audio peaks which would cause overmodulation are limited by the modulation limiter (V109). The limiter instantaneously limits the slope of the audio wave, preventing overmodulation, but preserving the intelligibility of the transmission.

TEST EQUIPMENT

1. An audio oscillator.
2. A frequency modulation monitor.
3. An output meter or a vacuum tube voltmeter.

PROCEDURE

1. Connect the audio oscillator and the meter across pins 1 and 2 of the microphone receptacle on the power supply chassis. (Pin 1 is the audio low.)

2. Apply a 1.0-volt signal at 1000 cps across the microphone terminals.

3. Disconnect the microphone from the control unit, and key the transmitter by means of the test switch on mobile transmitters or by grounding pin 3 of the microphone jack in station transmitters.

4. Set R186, the MOD control, for a 13 to 15-kilocycle swing (5-kilocycles for Narrow-Band) as indicated on the frequency modulation monitor.

If no audio oscillator is available, the modulation level control can be set by connecting a microphone to the transmitter, whistling a loud, clear tone into the microphone, and setting the MOD control (R186) for a 13 to 15-kilocycle swing*, as indicated on the modulation monitor.

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*Because of the high selectivity of General Electric Mobile Radio equipment, excessively high swings can impair communication effectiveness as well as excessively low swings. Within the range of settings recommended, good performance should be obtained. In general, more problems arise from high swing settings than from low; for this reason, the modulation control is set for ± 13 kilocycles ± 5 kilocycles for Narrow-Band) when the equipment is shipped from the factory.

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.

SIMPLIFIED BENCH ALIGNMENT PROCEDURE

ions are intended for retuning Transmitter ET-20-A and ET-21-A. If the transmitter is badly misaligned, or if the he transmitter is to be changed, refer to the complete TRANSMITTER BENCH ALIGNMENT PROCEDURE (see Table of Contents).

ONS

YSTAL is connected between pins 4 and 6 of crystal socket XY101 (Channel B crystal between pins 2 and 8 for two-) and ANTENNA or other load is connected to transmitter.

-OPERATE switch in TUNE position.

COUPLING control to its extreme CLOCKWISE position.

ON and allow 30 seconds for WARMUP.

quency transmitters, turn Channel Selector Switch to CHANNEL A.

llator frequency using an approved frequency meter. If necessary, set transmitter on frequency by means FREQ ADJ A (C101).

he transmitter for longer than 30 seconds in each minute until the 4th Multiplier Plate has been tuned.

r can be completely tuned using the 0 to 3-volt scale of a 20,000 ohm-per-volt voltmeter. ings given are those which should be obtained using such a meter.

	TUNING CONTROL	METER READING	PROCEDURE
B ck			A meter reading of approximately 1.5 volts or more indicates proper operation of Oscillator and Modulator stages. GND jack J508 is located on Power Supply chassis.
	Z101-L1 (1) (Mult-1 Plate)	Maximum (1.6 volts *)	
	Z102-L1 (2) (Mult-2 Plate) Z103-L1 (3) (Mult-3 Grid)	Maximum (1.8 volts *)	Alternately peak Z102 and Z103. If both Z102 and Z103 are badly misaligned, refer to TRANSMITTER BENCH ALIGNMENT PROCEDURE. Check tuning with wavemeter.
	Z104-L1 (4) (Mult-3 Plate) Z105-L1 (Mult-4 Grid) (5)	Maximum (1.6 volts *)	Alternately peak Z104 and Z105. If necessary, pretune Z104 by tuning for dip at J103. Fixed bias on Mult-4 grid will appear as small reading (0.5 to 1.0 volt) at J104, whether or not Z104 and Z105 are tuned.
	MULT-4 PLATE and PA GRID (in ET-20-A only)	Maximum	Fixed bias on PA grid will appear as small initial reading at PA GRID jack. When changing frequency of Transmitter Model ET-21-A, coil spacing of L106 and shorting bar on L113 must be adjusted as directed in TRANSMITTER BENCH ALIGNMENT PROCEDURE.
PA	PA PLATE (C150 or C157)	Minimum (DIP)	
	MULT-4 PLATE (C140) and PA GRID (ET-20-A only)	Minimum (DIP)	Dip MULT-4 PLATE and PA GRID controls, turn TUNE-OPERATE switch to OPERATE, and quickly redip tuning controls.
	PA PLATE (C150 or C157) and ANT TUNING (C153)	Minimum (DIP)	Tune PA PLATE and ANT TUNING controls alternately until lower meter reading cannot be obtained.
	ANT TUNING (C153)	Maximum	If no peak is observed, increase setting of ANT COUPLING control slightly until ANT TUNING control may be tuned for slight peak.
	ANT COUPLING (L114)	1.4 volts	
	ANT TUNING (C153)	Maximum	
	ANT COUPLING (L114)	1.6 volts in ET-20-A 1.5 volts in ET-21-A	
k	MULT-4 PLATE (C140) and PA GRID (ET-20-A only)	Maximum (1-1.5 volts in ET-20-A)* (2 volts ET-21-A)*	
PA	ANT TUNING (C153)	Maximum	
	ANT COUPLING (L114)	1.6 volts in ET-20-A 1.5 volts in ET-21-A	

reading to be expected when tuning with 0 to 3-volt, 20,000 ohm-per-volt voltmeter. If possible, tune to exceed

NES INDICATE TUNING CONTROLS.

INES INDICATE METERING JACKS.

Service Outline

144-152 MC TRANSMITTER
MODELS 4ET20 & 21A1, 11
152-174 MC TRANSMITTER
MODELS 4ET20 & 21A2, 12

(RC-344J)

7. Back the ANT COUPLING off in a clockwise direction until a slight decrease in the brilliance of I101 is noted.

MODULATION LEVEL ADJUSTMENT

The modulation level control, R186, was adjusted to the proper setting before shipment and should not normally require re-adjustment. This setting permits approximately 60 percent modulation for the average voice level. The occasional audio peaks which would cause overmodulation are limited by the modulation limiter (V109). The limiter instantaneously limits the slope of the audio wave, preventing overmodulation, but preserving the intelligibility of the transmission.

TEST EQUIPMENT

1. An audio oscillator.

2. A frequency modulation monitor.

3. An output meter or a vacuum tube voltmeter.

PROCEDURE

1. Connect the audio oscillator and the meter across pins 1 and 2 of the microphone receptacle on the power supply chassis. (Pin 1 is the audio low.)

2. Apply a 1.0-volt signal at 1000 cps across the microphone terminals.

3. Disconnect the microphone from the control unit, and key the transmitter by means of the test switch on mobile transmitters or by grounding pin 3 of the microphone jack in station transmitters.

4. Set R186, the MOD control, for a 13 to 15-kilocycle swing (5-kilocycles for Narrow-Band) as indicated on the frequency modulation monitor.

If no audio oscillator is available, the modulation level control can be set by connecting a microphone to the transmitter, whistling a loud, clear tone into the microphone, and setting the MOD control (R186) for a 13 to 15-kilocycle swing*, as indicated on the modulation monitor.

---

*Because of the high selectivity of General Electric Mobile Radio equipment, excessively high swings can impair communication effectiveness as well as excessively low swings. Within the range of settings recommended, good performance should be obtained. In general, more problems arise from high swing settings than from low; for this reason, the modulation control is set for ± 13 kilocycles ± 5 kilocycles for Narrow-Band) when the equipment is shipped from the factory.

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.

(D-7668907, Rev. 10)

	TYPICAL VOLTAGE READINGS FROM TUBE SOCKET PINS TO GND.											TYPICAL RESISTANCE READINGS FROM TUBE SOCKET PINS TO GND.								
	9	8	7	6	5	4	3	2	1	SYMBOL	TUBE TYPE	1	2	3	4	5	6	7	8	9	
③	—	—	155	155	①	②	②	.05	①	V101	6BH6	100K	4	⑤	⑤	∞	∞	∞	—	—	③
③	—	—	155	155	200	②	②	7	①	V201	6BH6	100K	∞	⑤	⑤	∞	∞	∞	—	—	③
	①	9	0	①	②	②	75	①	200	V102	6U8	∞	200K	500K⑥	⑤	⑤	130K⑥	0	3300	400K⑦	
	—	—	0	215	①	②	②	0	①	V103	6BH6	100K	0	⑤	⑤	120K⑥	190K⑥	0	—	—	
	①	210	0	①	②	②	210	①	15	V104	6CL6	560	80K	160K⑥	⑤	⑤	150K⑥	0	160K⑥	80K	
	—	0	②	0	①	0	200	②	0	V106	2E26	0	⑤	170K⑥	0	40K	0	⑤	0	—	
	—	0	②	1.5	①	1.5	160	②	1.5	V107	6146	5	⑤	300K⑥	5	17K	5	⑤	0	—	
	—	0	②	1.5	①	1.5	160	②	1.5	V108	6146	5	⑤	300K⑥	5	17K	5	⑤	0	—	
④	②	6.8	0	150	②	②	3.0	-0.6	65	V109	12AU7	380K⑥	570K	3900	⑤	⑤	180K⑥	47K	3900	⑤	
④	②	3.6	0	85	②	②	1	0	42	V110	12AU7	240K⑥	100K	470	⑤	⑤	240K⑥	100K	2200	⑤	

READINGS ARE TYPICAL VOLTAGES MEASURED ON A 20,000 OHM-PER-VOLT VOLTMETER (SCALES OF 3, 12, 60, 300, 600 VOLTS) WITH THE TRANSMITTER LOADED TO RATED CATHODE CURRENT.

① MEASUREMENT OF VOLTAGE AT THIS POINT WOULD UPSET OPERATION OF CIRCUIT.

② FILAMENT CIRCUIT. ON 6-V BATTERY, PIN CONNECTED WITH ORANGE WIRE READS 0V; ON 12-V BATTERY, PIN CONNECTED WITH ORANGE WIRE READS ABOUT 12.6V. PIN CONNECTED WITH BROWN WIRE READS ABOUT 5.6 V WITH 6-V BATTERY AND ABOUT 6.3 V WITH 12-V BATTERY.

③ CHANNEL SELECTOR SWITCH ON CHAN A (2-FREQUENCY TRANSMITTER).

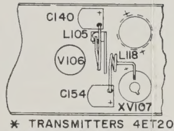
④ NO MODULATION.

READINGS ARE TYPICAL RESISTANCES MEASURED WITH ALL POWER REMOVED FROM TRANSMITTER AND WITH CABLES CONNECTED AND TUBES IN PLACE.

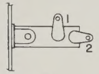
⑤ FILAMENT CIRCUIT. VERY LOW RESISTANCE.

⑥ CAPACITOR CHARGING WILL BE NOTED WHEN MEASURING. ALLOW METER TO RISE TO HIGHEST READING.

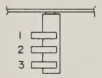
⑦ MOD CONTROL TURNED FULLY CLOCKWISE.


C140
L105
V106
L118
C154
XV107

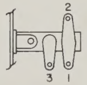
* TRANSMITTERS 4ET20A2 AND 12 ARE SIMILAR TO TRANSMITTERS 4ET21A2 AND 12 EXCEPT FOR THE DIFFERENCES SHOWN ABOVE.



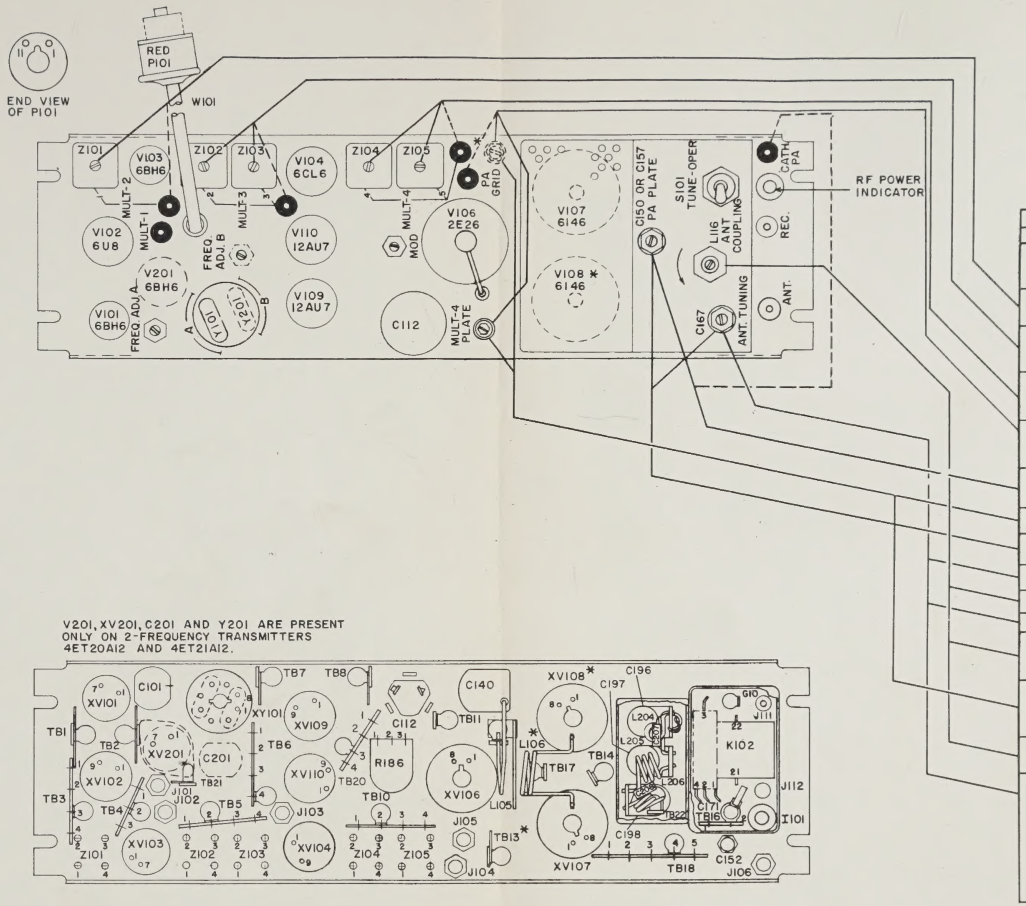
TERMINAL VIEW OF TB7, TB8, TB13 AND TB15.



TERMINAL VIEW OF TB21



TERMINAL VIEW OF TB1 AND TB2


END VIEW OF P101
RED P101
W101
Z101
V103 6BH6
Z102
Z103
V104 6CL6
Z104
Z105
PA GRID
CATH PA
RF POWER INDICATOR
MULT-2
MULT-1
MULT-3
MULT-4
V102 6U8
V110 12AU7
V109 12AU7
V201 6BH6
V101 6BH6
FREQ. ADJ. A
FREQ. ADJ. B
Y101
Y201
A
B
MOD
V106 2E26
C112
MULT-4 PLATE
V107 6146
V108 6146 *
C150 OR C157 PA PLATE
S101 TUNE-OPER
L116 ANT COUPLING
C167
ANT. TUNING
REC.
ANT.
TB1
TB2
TB3
TB4
TB5
TB6
TB7
TB8
TB10
TB11
TB13 *
TB14
TB16
TB17
TB18
TB20
TB21
XV101
XV102
XV103
XV104
XV106
XV107
XV108 *
XV109
XV110
XV201
XY101
C101
C201
C112
C140
C152
C171
C196
C197
C198
R186
L106 *
L105
L204
L205
L206
K102
J101
J102
J103
J104
J105
J106
J111
J112
Z101
Z102
Z103
Z104
Z105
Z101
G10

V201, XV201, C201 AND Y201 ARE PRESENT ONLY ON 2-FREQUENCY TRANSMITTERS 4ET20A12 AND 4ET21A12.

SIMPLIFIED BENCH ALIGNMENT PROCEDURE

These instructions are intended for retuning Transmitter ET-20-A and ET-21-A. If the transmitter is badly misaligned, or if the frequency of the transmitter is to be changed, refer to the complete TRANSMITTER BENCH ALIGNMENT PROCEDURE (see Table of Contents).

PRELIMINARY OPERATIONS

1. Be sure CRYSTAL is connected between pins 4 and 6 of crystal socket XY101 (Channel B crystal between pins 2 and 8 for two-frequency operation) and ANTENNA or other load is connected to transmitter.

2. Place TUNE-OPERATE switch in TUNE position.

3. Rotate ANT COUPLING control to its extreme CLOCKWISE position.

4. Turn POWER ON and allow 30 seconds for WARMUP.

5. On two-frequency transmitters, turn Channel Selector Switch to CHANNEL A.

6. Check oscillator frequency using an approved frequency meter. If necessary, set transmitter on frequency by means of crystal trimmer FREQ ADJ A (C101).

NOTE: Do not key the transmitter for longer than 30 seconds in each minute until the 4th Multiplier Plate has been tuned.

The transmitter can be completely tuned using the 0 to 3-volt scale of a 20,000 ohm-per-volt voltmeter. The meter readings given are those which should be obtained using such a meter.

METERING JACK		TUNING CONTROL	METER READING	PROCEDURE
—	+			
MULT-1 J101 green	GND J508 black			A meter reading of approximately 1.5 volts or more indicates proper operation of Oscillator and Modulator stages. GND jack J508 is located on Power Supply chassis.
MULT-2 J102 green	"	Z101-L1 (1) (Mult-1 Plate)	Maximum (1.6 volts *)	
MULT-3 J103 green	"	Z102-L1 (2) (Mult-2 Plate) Z103-L1 (3) (Mult-3 Grid)	Maximum (1.8 volts *)	Alternately peak Z102 and Z103. If both Z102 and Z103 are badly misaligned, refer to TRANSMITTER BENCE ALIGNMENT PROCEDURE. Check tuning with wavemeter.
MULT-4 J104 green	"	Z104-L1 (4) (Mult-3 Plate) Z105-L1 (Mult-4 Grid) (5)	Maximum (1.6 volts *)	Alternately peak Z104 and Z105. If necessary, pretune Z104 by tuning for dip at J103. Fixed bias on Mult-4 grid will appear as small reading (0.5 to 1.0 volt) at J104, whether or not Z104 and Z105 are tuned.
PA GRID J105 green	"	MULT-4 PLATE and PA GRID (in ET-20-A only)	Maximum	Fixed bias on PA grid will appear as small initial reading at PA GRID jack. When changing frequency of Transmitter Model ET-21-A, coil spacing of L106 and shorting bar on L113 must be adjusted as directed in TRANSMITTER BENCH ALIGNMENT PROCEDURE.
GND J508 black	CATH PA J106 red	PA PLATE (C150 or C157)	Minimum (DIP)	
"	"	MULT-4 PLATE (C140) and PA GRID (ET-20-A only)	Minimum (DIP)	Dip MULT-4 PLATE and PA GRID controls, turn TUNE-OPERATE switch to OPERATE, and quickly redip tuning controls.
"	"	PA PLATE (C150 or C157) and ANT TUNING (C153)	Minimum (DIP)	Tune PA PLATE and ANT TUNING controls alternately until lower meter reading cannot be obtained.
"	"	ANT TUNING (C153)	Maximum	If no peak is observed, increase setting of ANT COUPLING control slightly until ANT TUNING control may be tuned for slight peak.
"	"	ANT COUPLING (L114)	1.4 volts	
"	"	ANT TUNING (C153)	Maximum	
"	"	ANT COUPLING (L114)	1.6 volts in ET-20-A 1.5 volts in ET-21-A	
PA GRID J105 green	GND J508 black	MULT-4 PLATE (C140) and PA GRID (ET-20-A only)	Maximum (1-1.5 volts in ET-20-A)* (2 volts ET-21-A)*	
GND J506 black	CATH PA J106 red	ANT TUNING (C153)	Maximum	
"	"	ANT COUPLING (L114)	1.6 volts in ET-20-A 1.5 volts in ET-21-A	

* Approximate meter reading to be expected when tuning with 0 to 3-volt, 20,000 ohm-per-volt voltmeter. If possible, tune to exceed given reading.

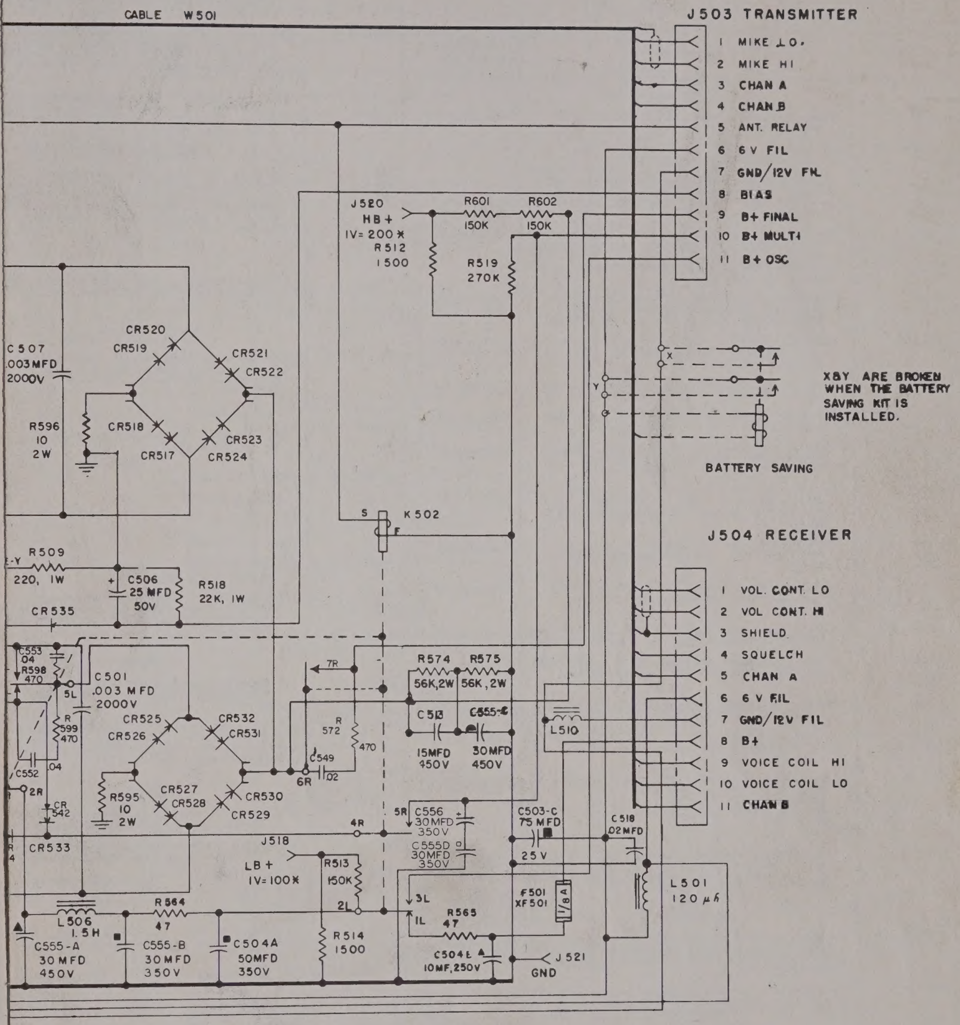
——— SOLID LINES INDICATE TUNING CONTROLS.

– – – BROKEN LINES INDICATE METERING JACKS.

Service Outline

144-152 MC TRANSMITTER
MODELS 4ET20 & 21A1, 11
152-174 MC TRANSMITTER
MODELS 4ET20 & 21A2, 12

(RC-344J)


CABLE W501
J503 TRANSMITTER
1 MIKE LO.
2 MIKE HI
3 CHAN A
4 CHAN B
5 ANT. RELAY
6 6 V FIL
7 GND/12V FIL
8 BIAS
9 B+ FINAL
10 B+ MULTI
11 B+ OSC
J520
HB+
IV= 200 *
R512
1500
R601
150K
R602
150K
R519
270K
C507
.003 MFD
2000V
CR520
CR519
CR521
CR522
CR518
CR523
CR517
CR524
R596
10
2W
X
Y
X&Y ARE BROKEN WHEN THE BATTERY SAVING KIT IS INSTALLED.
BATTERY SAVING
S
K502
F
J504 RECEIVER
1 VOL. CONT. LO
2 VOL. CONT. HI
3 SHIELD
4 SQUELCH
5 CHAN A
6 6 V FIL
7 GND/12V FIL
8 B+
9 VOICE COIL HI
10 VOICE COIL LO
11 CHAN B
R509
220, 1W
C506
25 MFD
50V
R518
22K, 1W
CR535
C553
.04
R598
470
C501
.003 MFD
2000V
5L
R
599
470
CR525
CR526
CR532
CR531
7R
R574
56K,2W
R575
56K,2W
R
572
470
C549
6R
.02
C513
15MFD
450V
C555-C
30MFD
450V
L510
C552
.04
2R
CR
542
R595
10
2W
CR527
CR528
CR530
CR529
CR533
4R
5R
C556
30MFD
350V
C555D
30MFD
350V
C503-C
75 MFD
25 V
C518
.02MFD
L501
120 μh
J518
LB+
IV= 100 *
R513
150K
2L
3L
1L
F501
XF501
1/8 A
R564
47
L506
1.5H
C555-A
30 MFD
450V
C555-B
30 MFD
350V
C504A
50MFD
350V
R514
1500
R565
47
C504B
10MF,250V
J521
GND

Elementary Diagram

HI POWER MOBILE POWER SUPPLY
MODEL 4EP2B1, REV. S

(D-7668793, Rev. 28)

HINTS FOR SERVICING

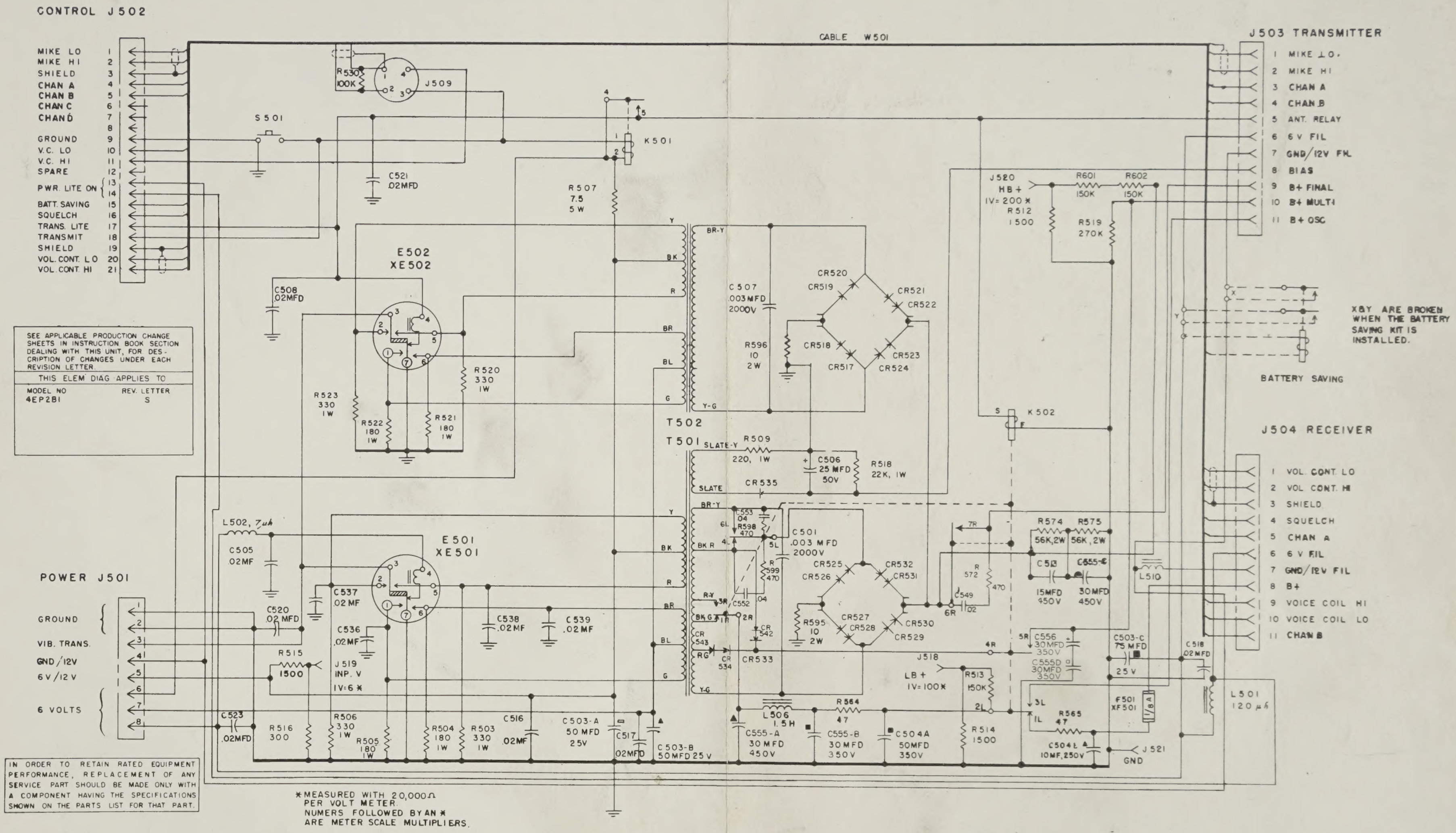
The following list of service hints, in addition to the table of typical metering voltages and the voltage-resistance chart (see reverse side) will assist the serviceman in locating the source of trouble if the Transmitter should fail to operate properly.

SYMPTOM	POSSIBLE CAUSE
No filament or B-plus voltage.	Power Supply failure. (a) Refer to SERVICE OUTLINE for transmitter Power Supply.
Low filament or B-plus voltage.	Fault in Power Supply. (a) Refer to SERVICE OUTLINE for transmitter Power Supply.
	Defect in B-plus or filament circuits causing excessive current drain.
	Power amplifier stage not properly tuned. (a) Retune PA.
No grid voltage at J101, the MULT-1 jack.	Defect in oscillator or modulator stage. (a) Test oscillator and modulator tubes. (b) If possible, test crystal by replacement with one known to be good. (c) Crystal plugged into wrong socket pins.
	Faulty relay contacts.
Low grid voltage in multiplier or power amplifier stages.	Defect in preceding stage. (a) Test the tube used in preceding stage and in stage under test. (b) Retune preceding stage; check tuning of coils with a wavemeter.
Good meter reading at J103, but no drive to 2E26 (J104).	Z103 and Z104 tuned to wrong harmonic of crystal frequency. (a) Check tuning of Z103 and Z104 with a wavemeter.
Power amplifier fails to load properly.	Defective power amplifier tube. (a) Try new power amplifier tube(s).
	Low grid voltage on power amplifier tube(s). (a) Check tuning of multiplier stages. (b) Check B-plus voltage.
Continued.	Open antenna circuit. (a) Check antenna connections. (b) Check antenna relay.
	Low-pass filter short circuited.
Transmitter operating without modulation or with low modulation.	Defect in microphone circuit. (a) Check position of MOD control (R186). (b) Check microphone, microphone cable and plug for open or short circuit. (c) Check control cable for open or short in microphone leads. (d) Test audio amplifier, modulation and limiter tubes.
Excessive swing.	R186 improperly set. (a) Reset MOD control using FM monitor. (b) Deemphasis capacitor C184 open.
Transmitter fails to key properly.	Defect in keying relay. (a) Refer to SERVICE OUTLINE for Power Supply.
	Defect in antenna relay circuit. (a) Check contacts on antenna relay (K101).

TYPICAL METERING VOLTAGES

JACK		CIRCUIT	METER READING*	
			4ET20A2, 12	4ET21A2, 12
MULT-1	J101	Mult-1 Grid (Doubler)	1.5 volts	1.5 volts
MULT-2	J102	Mult-2 Grid (Tripler)	1.6 volts	1.6 volts
MULT-3	J103	Mult-3 Grid (Doubler)	1.8 volts	1.8 volts
MULT-4	J104	Mult-4 Grid (Doubler)	1.6 volts	1.6 volts
PA GRID	J105	PA Grid	1-1.5 volts	2.2 volts
CATH PA	J106	PA Cathode	1.6 volts	1.5 volts

* Typical meter readings on 0 to 3-volt scale of a 20,000 ohm-per-volt voltmeter.


CONTROL J502
MIKE LO 1
MIKE HI 2
SHIELD 3
CHAN A 4
CHAN B 5
CHAN C 6
CHAN D 7
8
GROUND 9
V.C. LO 10
V.C. HI 11
SPARE 12
PWR. LITE ON 13 14
BATT. SAVING 15
SQUELCH 16
TRANS. LITE 17
TRANSMIT 18
SHIELD 19
VOL. CONT. LO 20
VOL. CONT. HI 21
CABLE W501
R530 100K
J509
S501
C521 .02MFD
K501
R507 7.5 5W
E502 XE502
C508 .02MFD
R520 330 1W
R523 330 1W
R522 180 1W
R521 180 1W
T502
T501
BR-Y
C507 .003MFD 2000V
CR520
CR519
CR521
CR522
CR518
CR517
CR523
CR524
R596 10 2W
Y-G
SLATE-Y
R509 220, 1W
C506 25 MFD 50V
R518 22K, 1W
SLATE
CR535
J520 HB+ 1V= 200 *
R512 1500
R601 150K
R602 150K
R519 270K
K502
L502, 7μh
C505 .02MF
E501 XE501
C537 .02 MF
C520 .02 MFD
C536 .02MF
R515 1500
J519 INP. V 1V÷6 *
C538 .02MF
C539 .02MF
POWER J501
GROUND
VIB. TRANS.
GND/12V
6V/12V
6 VOLTS
C523 .02MFD
R516 300
R506 330 1W
R505 180 1W
R504 180 1W
R503 330 1W
C516 .02MF
C503-A 50 MFD 25V
C517 .02MFD
C503-B 50MFD 25V
C553 .04
R598 470
R599 470
C501 .003 MFD 2000V
CR525
CR526
CR532
CR531
CR527
CR528
CR529
CR530
C552 .04
CR543
CR542
CR534
CR533
R595 10 2W
R572 470
C549 .02
R574 56K, 2W
R575 56K, 2W
C512 15MFD 450V
C555-C 30MFD 450V
L510
C556 30MFD 350V
C555D 30MFD 350V
C503-C 75 MFD 25V
J518 LB+ 1V= 100 *
R513 150K
L506 1.5H
R564 47
C555-A 30 MFD 450V
C555-B 30 MFD 350V
C504A 50MFD 350V
R514 1500
R565 47
C504 L 10MF, 250V
F501 XF501 1/8 A
J521 GND
C518 .02MFD
L501 120 μh
J503 TRANSMITTER
1 MIKE LO.
2 MIKE HI
3 CHAN A
4 CHAN B
5 ANT. RELAY
6 6 V FIL
7 GND/12V FIL
8 BIAS
9 B+ FINAL
10 B+ MULTI
11 B+ OSC
X
Y
BATTERY SAVING
J504 RECEIVER
1 VOL. CONT. LO
2 VOL. CONT. HI
3 SHIELD
4 SQUELCH
5 CHAN A
6 6 V FIL
7 GND/12V FIL
8 B+
9 VOICE COIL HI
10 VOICE COIL LO
11 CHAN B

X&Y ARE BROKEN WHEN THE BATTERY SAVING KIT IS INSTALLED.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV. LETTER
4EP2B1	S

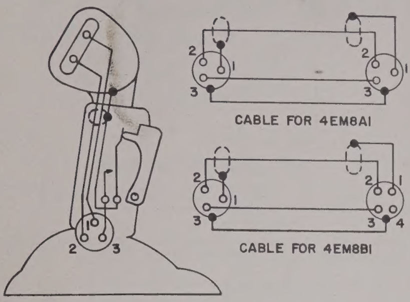
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

*MEASURED WITH 20,000Ω PER VOLT METER.
NUMERS FOLLOWED BY AN *
ARE METER SCALE MULTIPLIERS.

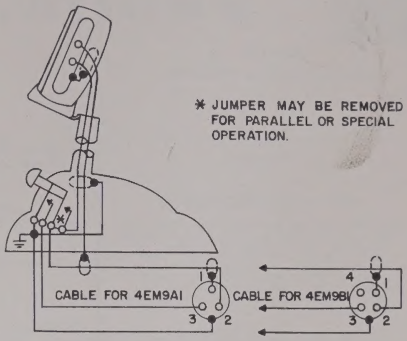
Elementary Diagram

HI POWER MOBILE POWER SUPPLY
MODEL 4EP2B1, REV. S

(D-7668793, Rev. 28)

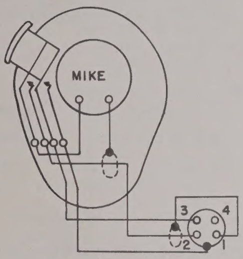

2
1
3
2
1
3
CABLE FOR 4EM8A1
2
1
3
2
1
3
4
CABLE FOR 4EM8B1
1
2
3

DESK MICROPHONE MODELS 4EM8A1,B1


*
CABLE FOR 4EM9A1
1
3
2
CABLE FOR 4EM9B1
4
1
3
2

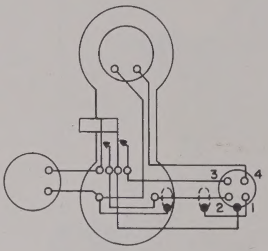
* JUMPER MAY BE REMOVED FOR PARALLEL OR SPECIAL OPERATION.

DESK MICROPHONE MODELS 4EM9A1, B1



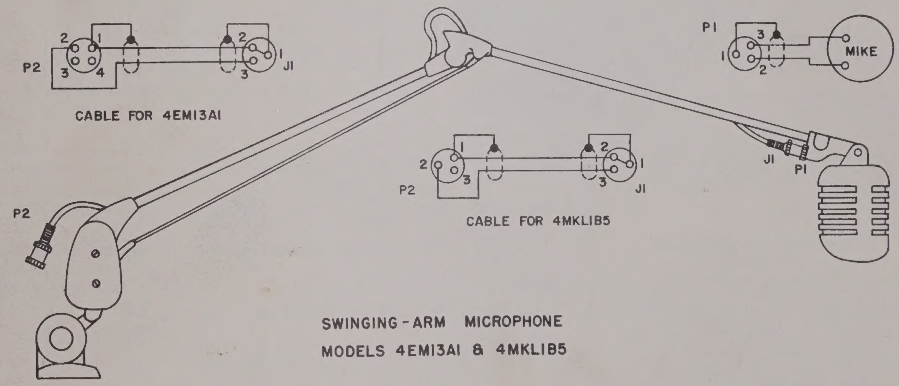
MILITARY TYPE MICROPHONE

MODELS 4EM10A1,2 AND 4EM10B1,2



TELEPHONE HANDSET

MODEL 4EM12A1


2
1
P2
3
4
2
1
3
J1
CABLE FOR 4EM13A1
P1
3
1
2
MIKE
J1
P1
1
2
2
1
3
3
P2
J1
CABLE FOR 4MKL1B5
P2

SWINGING-ARM MICROPHONE

MODELS 4EM13A1 & 4MKL1B5

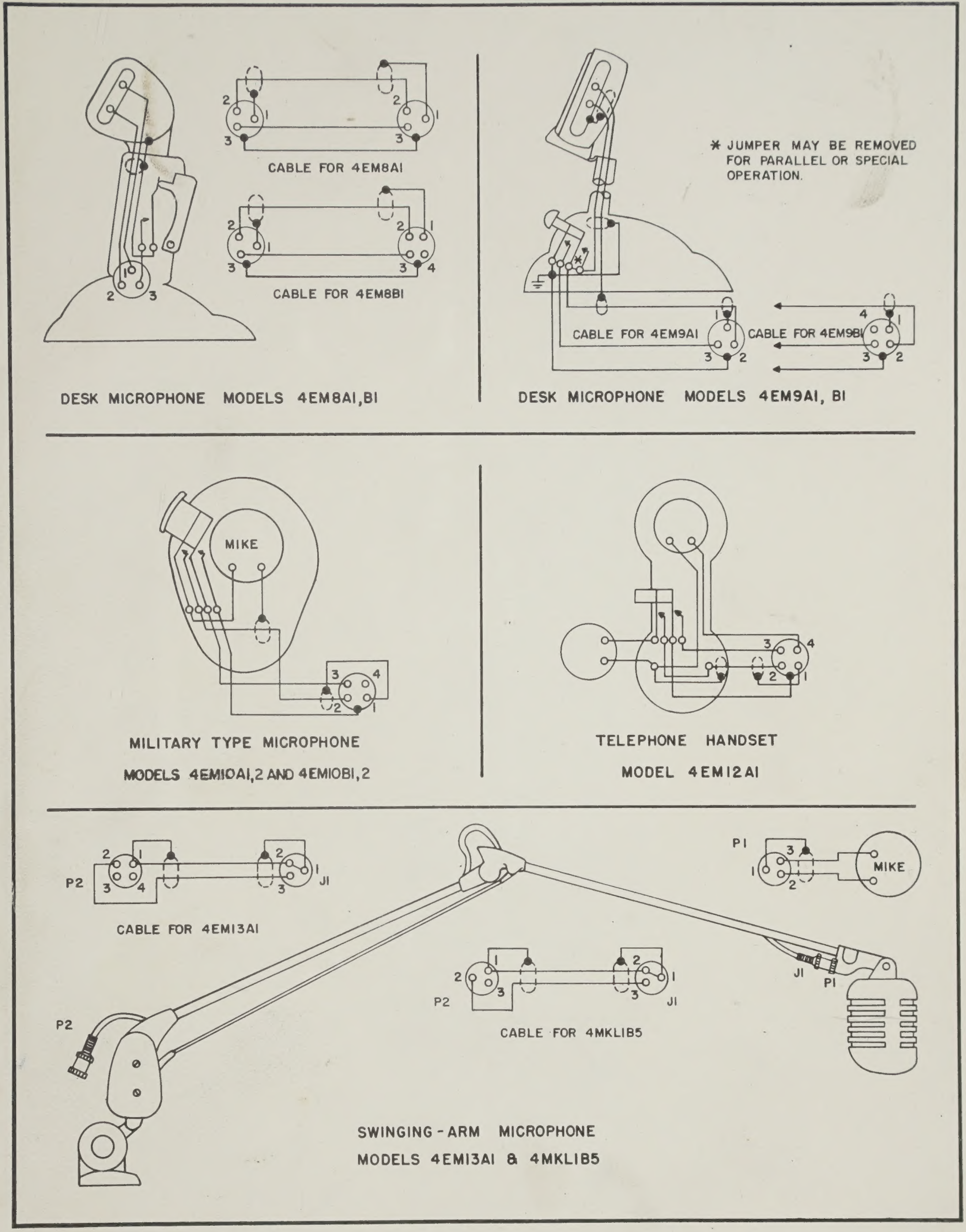
Elementary Diagram

CONTROLLED-RELUCTANCE MICROPHONES

(RC-302E)

PARTS LIST
POWER SUPPLY
MODEL 4EP2BI
REV. S

SYMBOL	DESCRIPTION	G-E DRAWING & PART NO.
	CAPACITORS	
C501	Paper oilfilled, metal case, 0.003 mfd ± 20%, 2000 v d-c w.	M-7476463-P20
C502#	Electrolytic, polarized, twist prong base. Similar to Mallory Type FP. Section A ■ : 30 mfd +100% -10%, 350 v d-c w; Section B ☐ : 30 mfd +100% -10%, 350 v d-c w; Section C ▲ : 30 mfd +50% - 10%, 450 v d-c w; Section D ● : 30 mfd +50% -10%, 450 v d-c w. (Deleted by Rev. N.)	P-7772415-P46
C503#	Electrolytic, non-polarized, twist prong base. Section A ☐ : 50 mfd, +100% -10%, 25 v d-c w; Section B ▲ : 50 mfd, +100% -10%, 25 v d-c w; Section C ■ : 75 mfd, +100% -10%, 25 v.d-c w Changed by Rev. H.	P-7774297-P1
C504	Electrolytic, polarized, twist-prong base; 2-section, 50/10 uf +100% -10%, 350/250 VDCW. Sprague Electric Mfg. Co. Type S53687.	C-5494560-P4
C505	Ceramic, insulated, Hi-K disc; 0.02 uf +80% -20%, 450 VDCW. Centralab Mfg. Co. Type DA-145.	B-7488160-P2
C506	Electrolytic, tubular, 25 mfd +250% -10%, 50 v d-c w. Mallory Cat. #TC36.	C-7774786-P8
C507	Paper, oilfilled, metal case, 0.003 mfd ± 20%, 2000 v d-c w.	M-7476463-P20
C508	Ceramic, insulated, Hi-K disc; 0.02 uf +80% -20% 450 VDCW. Centralab Mfg. Co. Type DA-145.	B-7488160-P2
C513#	Electrolytic, insulated, tubular; sealed in metal tube, 15 uf +50% -10%, 450 VDCW. Sprague Mfg. Co. Cat. No. 64981. (Changed by Rev. N.)	B-5491387-P4
C516 thru C518	Ceramic, insulated, Hi-K disc; 0.02 uf +80% -20%, 450 VDCW. Centralab Mfg. Co. Type DA-145.	B-7488160-P2
C528 and C521	Ceramic, insulated, Hi-K disc; 0.02 uf +80% -20%, 450 VDCW. Centralab Mfg. Co. Type DA-145.	B-7488160-P2
C523	Ceramic, insulated, Hi-K disc; 0.02 uf +80% -20%, 450 VDCW. Centralab Mfg. Co. Type DA-145.	B-7488160-P2
C536 thru C539	Ceramic, insulated, Hi-K disc; 0.02 uf +80% -20%, 450 VDCW. Centralab Mfg. Co. Type DA-145.	B-7488160-P2
C548#	Ceramic, Hi-K disk; 0.02 ufd +100% -0%, 500 v d-c w. (Added by Rev. L.)	C-7774750-P15
C552# and C553#	Ceramic, Hi-K disk; 0.04 ufd +80% -20%, 500 v d-c w.(Added by Rev. M.)	B-7488160-P4
C555##	Electrolytic, polarized, twist-prong base; 3-section, 30/30/30/30 uf +50% -10%, 450/350/450/350. Sprague Electric Mfg. Co. Type S64982. (Added by Rev. N). Changed by Rev. S.	C-5494560-P5
C556##	Electrolytic, insulated, tubular sealed in y metal tube 30 uf + 50% -10%, 350 VDCW. Sprague Mfg. Co. Cat. No. 64981. (Added by Rev. N). Changed by Rev. S.	C-5491387-P5
	RECTIFIERS	
CR503#	Selenium; forward current 80/30 ma d-c, peak inverse 800 v per arm, connected for doubler. G-E Cat. #6RS21PD13BAFI. Changed by Rev. F. Deleted by Rev. L.	A-7144141-P3
CR504#	Selenium, forward current 50 ma, peak inverse 700 v per arm, entire stack connected for center tap. G-E Cat. #6RS21PC12BA1. Deleted by Rev. L.	A-7144141-P1
CR505#	Selenium; 1 cell, forward current 150 ma, peak inverse 64 v, connected for half wave. G-E Cat. #6RS21PH1ATF1. Deleted by Rev. L.	A-7140806-P1
CR506# and CR507#	Selenium; forward current 50 ma, peak inverse 800 v. per arm, connected for doubler. G-E Cat. #6RS21PD12BB1. Deleted by Rev. L.	A-7144141-P2
CR511#	Selenium; forward current 80/30 ma d-c, peak inverse 800 v per arm, connected for doubler. G-E Cat. #6RS21PD13BAF1. Changed by Rev. F. Deleted by Rev. L.	A-7144141-P3
CR517# thru CR534#	Rectifiers: silicon, half wave; hermetically sealed in glass insulated metal container peak volts 400, capacitive load inverse 300 ma, resistive load inverse 500 ma. G-E Cat. No. 1N1695. Westinghouse Cat. No. 1n1169. (Included in Component Board. G-E Dwg. and Group No. PL-4032363-GI and G2). (Added by Rev. L).	B-5490415-P2
CR535#	Rectifier: silicon; hermetically sealed, insulated, 100 piv, 70 vrms, dc output -500 ma at 25° C, 250 ma at 100°C, brown, G-E Cat. No. 1N1692. (Included in Component Board. G-E Dwg and Group No. PL-4032363-G2).	B-5492294-P1
CR542# and CR543#	Silicon rectifier; half wave, peak volts 400, capacitive load inverse 300, resistive load 500 ma. Similar to Westinghouse 1N169. Added by Rev. M.	B-5490415-P2
	MISCELLANEOUS ELECTRICAL PARTS	
E501 and E502	Vibrator, dual interrupter, split reed: operating voltage 6 v, input voltage range 4-8 v, reed frequency 115 cycles ± 7; pri interrupter capacity 48 v - amp. max current 8 amp, 1.3 w driving power. 7 pin base. Mallory Type 1701.	A-7141584-P3
	FUSE	
F501	1/8 amp, 250 v. Type 3AG, quick to med blowing. Littelfuse Cat. #312.125, Bussman Cat. #AGC-1/8.	K-1R16-P12
	JACKS AND RECEPTACLES	
J501	Connector: black-molded phenolic; insulated, 8-male pins, con-connecting polarizing pin, (mates with socket connector). HB Jones Type S-408.	A-4032745-P1
J502	Part of W501.	
J503 and J504	Part of W501. (Green goes to Received, red to Transmitter.	
J505#	Deleted by Rev. E.	
J506#	Deleted by Rev. E.	
J507#	Deleted by Rev. E.	
J508#	Deleted by Rev. E.	
J509	Chassis connector: 4 female contacts. Amphenol Type 91-PC4F.	K-7117934-P2
J518# thru J521#	Jack, metering; 4-pin, molded phenolic, Similar to Cinch Part #9800 except contact elements are made for use with 0.080" pins. Added by Rev. E.	A-7160854-P1
	RELAYS	
K501	Coil operating range 4.9 to 6.9 v d-c, resistance 50 ohms ± 10%, at 25°C, spdt contacts.	K-7127542-P2
K502	Minature telephone type; 7.2 v d-c operating max, pickup 4.5 v d-c or less, resistance 28 ohms ± 10%, 2 form A, 3 form C contacts. Potter Brumfield Type MJ-1194.	C-7774180-P1
	INDUCTORS	
L501	RF Choke coil; inductance 120 uh ± 10% at 1,000 cps, dc resistance 0.064 ohm max.	A-7143944-P1
L502	RF Choke coil: inductance 7.0 uh, current 1000 ma, 35 to 110 freq range. Ohmite Cat.#2-50.	P-7772834-P4
L506#	Reactor: inductance 1.5 h at 0.085 amps d-c, d-c resistance 150 ohms max, peak a-c ripple 10 v RMS at 60 cycles, d-c operating 200 v. Added by Rev. C.	B-7489398-P1
L510#	RF choke coil inductance 12- uh ± 10% at 1000 cps, d-c resistance 0.064 ohms max. Added by Rev. H.	A-7143944-P1
	RESISTORS	
R501#	Deleted by Rev. C.	
R502#	(Deleted by Rev. C).	
R503	Composition, 330 ohms ± 10%, 1 w.	C-3R78-P331K
R504 and R505	Composition, 180 ohms ± 10%, 1 w.	C-3R78-P181K
	RESISTORS (CONT'D)	
R506	Composition, 330 ohms ± 10%, 1 w.	C-3R78-P331K
R507	Wirewound, 7.5 ohms ± 10%, 5 w. Omit wire leads.	B-7487415-P108
R509	Composition, 220 ohms ± 10%, 1 w.	C-3R78-P221K
R510# and R511	Composition, 0.15 megohm ± 5%, 1/2 w. changed by Rev. R.	C-3R77-P154J
R512	Composition, 1500 ohms ± 5%, 1/2 w.	C-3R77-P152J
R513	Composition, 0.15 megohm ± 5%, 1/2 w.	C-3R77-P154J
R514 and R515	Composition, 1500 ohms ± 5%, 1/2 w.	C-3R77-P152J
R516	Composition, 300 ohms ± 5%, 1/2 w.	C-3R77-P301J
R518	Composition, 22,000 ohms ± 10%, 1 w.	C-3R78-P223K
R519	Composition, 0.27 megohm ± 10%, 1/2 w.	C-3R77-P274K
R520	Composition, 330 ohms ± 10%, 1 w.	C-3R78-P331K
R521 and R522	Composition, 180 ohms ± 10%, 1 w.	C-3R78-P181K
R523	Composition, 330 ohms ± 10%, 1 w.	C-3R78-P331K
R530	Composition, 0.10 megohm ± 10%, 1/2 w.	C-3R77-P104K
R542#	Deleted by Rev. C.	
R564# thru R565#	Composition, 47 ohms ± 10%, 1/2 w. Added by Rev. C.	C-3R77-P470K
R572#	Composition, 470 ohms ± 10%, 1/2 w. (Added by Rev. L).	C-3R77-P471K
R574 and R575	Composition, 56,000 ohms ± 10%, 2 w.	C-3R79=P563K
R595# and R596#	Composition, 10 ohms, ± 10%, 2 w. (Added by Rev. L).	C-3R79-P100K
R598# and R599#	Composition, 470 ohms ± 10%, 2 w. Added By Rev. M.	C-3R77-P471K
R601# and R602#	Composition, 150K ± 5%, 1 w. Added by Rev. R	C-3R78-P154J
	SWITCH	
S501	Push-button type, momentary contact: sp NO., red button, 1/2 amp at 115 v a-c. Grayhill Cat. #4001.	M-7491654-P1
	TRANSFORMERS	
T501	Vibrator power. Exciting current .300 amp max, .150 amp min. with 8 v, 60 cycles a-c applied to primary on red and yellow leads. Has 2 pri and 2 sec.	B-7486449-P1
T502#	Vibrator power. Exciting current .300 amp max. .150 amp min. with 8 v, 60 cycles a-c applied to primary on red and yellow leads. Has one secondary without taps. Added by Rev. D.	B-7486449-P2
	CABLE	
W501#	Cable assembly includes; one connector (J502) with 21-male contacts, HB Jones P-321-SB or equiv; two sockets with 11-female contacts (G-E Dwg. and Part No. A-4031522-P1:, with metal cap, metal stamped with the letter"T", (G-E Dwg. and Part No. A-4031519-P1); or two molded connectors, (J503 and J504)11 female contacts one green stamped with the letter "R", one red, stamped with the letter "T", Component Mfg. Service Cat. #1601-F11. (Changed by Rev. D).	C-7775913-P2
	SOCKETS	
XE501# and XE502#	Vibrator socket: black phenolic, 7-small contacts. Amphenol Type #M1P-7S. Changed by Rev. E.	K-1R14-P4
XF501	Fuse holder. Bussman Type HKP.	K-7115179-P1
	SUB-ASSEMBLIES	
	Component Board. Includes the following: CR517 thru CR524.	PL-4032363-GI
	Component Board. Includes the following: CR525 thru CR535.	PL-4032363-G2



CABLE FOR 4EM8A1
CABLE FOR 4EM8B1
1
2
3
4
* JUMPER MAY BE REMOVED FOR PARALLEL OR SPECIAL OPERATION.
CABLE FOR 4EM9A1
CABLE FOR 4EM9B1
MIKE
P1
P2
J1
CABLE FOR 4EM13A1
CABLE FOR 4MKL1B5

DESK MICROPHONE MODELS 4EM8A1,B1

DESK MICROPHONE MODELS 4EM9A1, B1

MILITARY TYPE MICROPHONE
MODELS 4EM10A1,2 AND 4EM10B1,2

TELEPHONE HANDSET
MODEL 4EM12A1

SWINGING-ARM MICROPHONE
MODELS 4EM13A1 & 4MKL1B5

150330

Elementary Diagram
CONTROLLED-RELUCTANCE MICROPHONES
(RC-302E)

PARTS LIST FOR CONTROLLED-RELUCTANCE MICROPHONES

SYMBOL	DESCRIPTION	G-E DRAWING & PART NO.
	DESK MICROPHONE MODEL 4EM8A1, B1	
	Microphone, controlled reluctance, Shure Bros. Model CR-41 microphone with Model S-36A desk stand, and Type A88A switch modified. Includes plastic or rubber covered, 3 conductor, one under shield cable. Shure Bros. Cable Spec #15A303A, 3 pin male plugs. Amphenol Type 91-MC3M. Used in 4EM8A1. Must have 33-485 Mu-Metal ring and 66A35 rubber mounting ring assembled.	M-7485051-P1
	Microphone controlled reluctance. Shure Bros. Model CR-41B microphone with Model S-36A desk stand, and Type A88A switch modified. Includes plastic or rubber covered, 3 conductor, one under shield, cable. Shure Bros. Cable Spec #15A303A, 3 pin male plug. Amphenol Type 91-MC3M. Has end of cable away from mike 4 pin male plug Amphenol Cat. #91-MC4M. Used in 4EM8B1. Must have 33-485 Mu-Metal ring and 66A35 rubber mounting ring assembled.	M-7485051-P2
	DESK MICROPHONE MODEL 4EM9A1, B1	
	Microphone and stand, controlled reluctance type. Shure Bros. Model CR-88. Load impedance 100,000 ohms approx, output 52.5 db below one volt per microbar. Includes 3 conductor, one under shield, plastic covered cable. Shure Bros. Cable Spec #15A303A, 3 pin male plug Amphenol Type #91-MC3M. Used with 4EM8A1. Must have 65A68 plastic acoustic cup assembled.	C-7774958-P1
	Microphone and stand, controlled reluctance type. Shure Bros. Model CR-88B. Load impedance 100,000 ohms approx, output 52.5 db below 1 v per microbar. Includes 3 conductor, one under shield, plastic covered cable. Shure Bros. Cable Spec #15A303A, 3 pin male plug Amphenol Type #91-MC3M and a connector Amphenol Type #91-MC4M. Used in 4EM9B1. Must have 65A68 plastic acoustic cup assembled.	C-7774958-P2
	MILITARY MICROPHONE MODEL 4EM10A1, 2	
	Microphone, hand, controlled reluctance: high impedance output at least 55 db below 1 v per microbar per 1 KC, includes 3 conductor, with one under shield, retractile tinsel cord. Shure Bros. Cable Spec #15A407A, 13" retracted length, and one 4 pin Amphenol plug Cat. #MC4M. Cable with 2 connectors assembled, Shure Bros. Spec #90H262. Must have 33-485 Mu-Metal ring and 66A35 rubber mounting ring assembled.	B-7488422-P1
	Microphone, hand, controlled reluctance: high impedance output at least 55 db below 1 v per microbar per 1KC, includes 3 conductor, with one under shield, retractile tinsel cord. Shure Bros. Cable Spec #15A407A, 13" retracted length, and one 4 pin Amphenol plug Cat. #MC4M. Cable with 2 connectors assembled, Shure Bros. Spec #90H262. Must have 33-485 Mu-Metal ring and 66A35 rubber mounting ring assembled.	B-7488422-P2
	Clip.	PLA-7141414-G1
	MOISTURE-PROOF MILITARY MICROPHONE MODEL 4EM10B1, 2	
	Microphone, hand, controlled-reluctance: high impedance output at least 55 db below 1 v per microbar per 1 kc, includes 3-conductor retractile tinsel cord with one conductor under shield. Shure Bros. Cable Spec #15A407A, 13" retracted length, and one 4-pin Amphenol plug Cat. #MC4M. Cable with 2 connectors assembled, Shure Bros. Spec. #90H262. Switch and all connections moisture-proofed. Must have 33-485 Mu-Metal ring and 66A35 rubber mounting ring assembled.	B-7488422-P2
	Microphone, hand, controlled-reluctance: high impedance output at least 55 db below 1 v per microbar per 1 kc, includes 3-conductor retractile tinsel cord with one conductor under shield. Shure Bros. Cable Spec #15A407A, 13" retracted length, and one 4-pin Amphenol plug Cat. #MC4M. Cable with 2 connectors assembled, Shure Bros. Spec. #90H262. Switch and all connections moisture-proofed. Must have 33-485 Mu-Metal ring and 66A35 rubber mounting ring assembled.	B-7488422-P2
	HANDSET MODEL 4EM12A1	
	Telephone handset with controlled reluctance transmitter. Includes Receiver Unit. Shure Bros. #99A148. Transmitter unit Shure Bros. #99A86. Cable: 4 conductor, one under shield, tinsel coiled cord with tangent ends. Shure Bros. Cable Spec. #15A407A, one male plug Amphenol Type 91-MC4M. Cable with 2 connectors assembled, Shure Bros. Spec #90L262.	B-7486495-P1
	Handset holder. W.E. Type KS-10080.	K-7101608-P4
	SWINGING-ARM MICROPHONE MODEL 4EM13A1	
	Microphone, multi-impedance, dynamic: moving coil type with freq range of 50 to 15,000 cps, has swivel adjustment from 0 to 80°. Shure Bros. Model 55S (DY12).	B-7487533-P1
	Microphone bracket: 24" reach, includes shielded two conductor rubber or PVC jacketed microphone cable, Belden Cat. #8412, 2 amphenol plugs Type 91 MC3M. Dazor Mfg. Co. Cat. MP-866. Also has 4 pin connector amphenol Type 91-MC4M on cable end away from mike.	C-7774934-P2
	SWINGING-ARM MICROPHONE MODEL 4MKL1B5	
	Microphone, multi-impedance, dynamic: moving coil type with freq range of 50 to 15,000 cps, has swivel adjustment from 0 to 80°. Shure Bros. Model 55S (DY12).	B-7487533-P1
	Microphone bracket: 24" reach, includes shielded two conductor rubber or PVC jacketed microphone cable, Belden Cat. #8412. 2 Amphenol plugs Type 91-MC3M. Dazor Mfg. Co. Cat. #MP-866.	C-7774934-P1

PROGRESS LINE

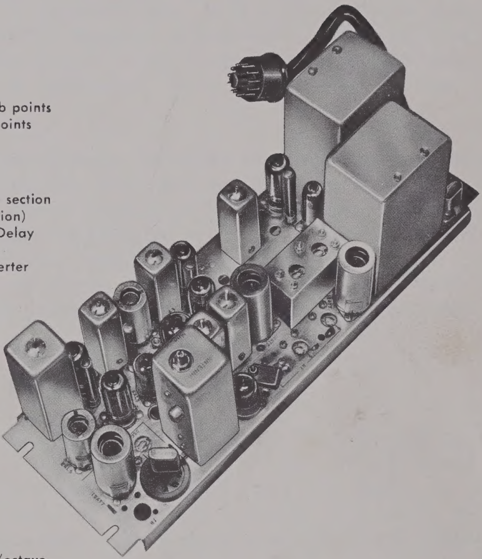
COMMUNICATION EQUIPMENT
SPECIFICATIONS

CHASSIS
R-3

Type	ER-25-C: Narrow band receiver for station or mobile use ER-25-D: Wide band receiver for station or mobile use
Frequency range	NARROW BAND: Model No. 4ER25C2 — 150.8-174 megacycles WIDE BAND: Model No. 4ER25D1 — 144-152 megacycles Model No. 4ER25D2 — 150.8-174 megacycles
Audio output	1.5 watts with less than 10% distortion
Sensitivity	0.5 uv (20 db quieting method)
Squelch	Adjustable, will open at less than 0.25 uv at critical setting
Selectivity:	
	NARROW BAND: 30 kc channels
(EIA method)	Adjacent channel 80 db down
20 db quieting method*	100 db ±25 kc
	WIDE BAND: 60 kc channels
EIA method	Adjacent channel 85 db down
20 db quieting method*	100 db ±40 kc
Band width by swing method of measurement	NARROW BAND: ±6 kc at the 6 db points WIDE BAND: ±15 kc at the 6 db points
Spurious responses	At least 100 db down

Tube complement

6AK5	RF Amplifier
6679/12AT7	1st Oscillator (2nd triode section for two-frequency operation)
6679/12AT7	1st Converter and AGC Delay
6679/12AT7	3x and 4x Multiplier
6679/12AT7	2nd Oscillator and Converter
6661/6BH6	Low–IF Amplifier
6661/6BH6	Low–IF Amplifier
6661/6BH6	1st Limiter
6661/6BH6	2nd Limiter
6663/6AL5	Discriminator
6663/6AL5	Noise Rectifier
6661/6BH6	Noise Amplifier
6681/12AX7	Audio Amplifier and Squelch
6669/6AQ5	Audio Output



Ambient temperature	−30°C to +60°C
Frequency stability over specified temperature range	Unheated crystal: ±0.002% Heated crystal: ±0.0005%
Audio frequency characteristics (EIA method)	Within +2 db to −8 db of a 6 db/octave de-emphasis from 300 to 3000 cps. 1000 cps. reference
Maximum recommended frequency spread in 2, 3 or 4 channel operation	0.4% of operating frequency (approximately 600 kc)
Size	13½" long x 4½" wide x 5¾" high
Weight	5 lbs.

*This figure included for comparison purposes only since this method is obsolete.

SCOPE OF SPECIFICATIONS—In the construction of the equipment described herein, the full intent of the specification will be met. It is assumed, however, that any departure from the specification, desirable for reasons of improved design or operation, will be permissible.

The equipment described above meets or exceeds all applicable EIA specifications.

GENERAL ELECTRIC
COMMUNICATION PRODUCTS DEPARTMENT
MOUNTAIN VIEW ROAD • LYNCHBURG, VA.

DESCRIPTION AND MAINTENANCE INSTRUCTIONS
FOR
RECEIVER MODELS
4ER25C1, 2, 11 & 12 AND 4ER25D1, 2, 11 & 12

General Electric FM Radio Receivers described here-in are Progress Line equipment, designed for operation on fixed frequencies within the 144 to 174 megacycle range of frequencies. These receivers have been assembled on 4-1/2 inch x 13-1/2 inch block chassis which mount directly to the framework of a mobile unit assembly, or to the chassis of a rack mounted power supply for a-c application. Operating voltages of 200 volts (nominal B+) and 6.2 volts or 13.2 volts (nominal "A") are derived from a power supply external to the receiver, thus permitting fixed/mobile versatility in two-way land mobile communication services. The external control and power terminations are made through an 11-conductor cable and plug which mate with a socket from the power supply chassis. Tuning controls, except for one multiplier adjustment, one antenna transformer adjustment, and the discriminator primary, are accessible from the top of the receiver chassis.

These receivers employ a double-conversion superheterodyne circuit with automatic gain control on the RF Amplifier and 14 tuned circuits in the IF stages. A dual tuned pre-selector provides maximum protection to the first stage against strong, undesired signals. Multiple-channel operation with as many as four frequencies is obtainable by the employment of options. The 17-inch case assembly is required for three and four frequency receiver mobile options.

APPLICATIONS

The receivers covered by these instructions may be used interchangeably between mobile and station installations when used with the correct power supply. No change or modification will be required in the receiver when transferring the unit from service to service, since changes in "A" voltages are taken care of in connections to the power supply.

TUBES

The tubes employed in the circuits of this receiver are widely accepted, highly efficient, long-life tubes and meet the requirements of the majority of installations. Communication type tubes are pre-tested tubes selected specifically to meet the requirements of two-way application. They are tested for heater cycling reliability, operation at ± 20% of filament ratings and stabilized for a predetermined period of time. As these tubes become available, they are being employed in this receiver and directly replace the standard tube types.

In certain mobile applications, where heavy shock and vibration are regularly encountered, a still more rugged tube, the G-E Five Star tube, may prove more economical. Five Star tubes are more ruggedly constructed, must pass more rigid tests, and are carefully "aged" before packaging. This results in greatly increased life, particularly under the severe vibration condition sometimes encountered in mobile installations. The Communication Type tubes and "Five-Star" tubes which are available for use in this receiver are listed below. Check with your tube supplier regarding the availability of those tubes marked with an asterisk.

Prototype Tube Type	Communication Tube Type	Five-Star Tube Type
6AK5		GL5654
6AL5	6663	GL5726
6AQ5	6669	GL6005
6BH6	6661	GL6265
12AT7	6679	GL6201
12AX7	6681	GL5751

Five-Star tubes are directly interchangeable for 6- or 12- volt operation. In 12-volt applications the heater voltages should be checked at both heater buses (brown wire and orange wire), since the GL5751 and the GL6265 require 0.175 ampere heater current per section; whereas their prototypes required 0.150 ampere. The extent of unbalance in the heater circuit depends on the number of tubes replaced and the location of Five-Star tubes used in the transmitter and receiver. A resistor may be added if required to keep the heaters balanced within this rating. The transmitter heaters must also be considered when checking the filament balance on 12-volt operation.

MAINTENANCE

Inspecting the receiver regularly will assure peak performance and lengthen the life of the equipment. In this way trouble may be anticipated and corrected before operational difficulties arise.

TEST EQUIPMENT

1. A 20,000 ohm-per-volt voltmeter with a 0-3 volt scale.

2. A 1000 ohm-per-volt A.C. voltmeter (Station Application only).

PROCEDURE

1. The first and most important reading is that of the 2nd limiter on noise. This reading when taken on the 0-3 volt scale of a 20,000 ohm-per-volt meter connected between J303 and ground should not fall below 0.9 volts. If this value is exceeded, it is likely

that the receiver is in good operating condition. If not, the trouble may be in the antenna or input circuits.

2. The 1st Oscillator grid metering voltage, as read on the 0-3 volt scale of a 20,000 ohm-per-volt meter connected between J305 and ground will be approximately 1.5 volts (when 1st Oscillator plate tank is correctly tuned). If this voltage drops below 1.2 volts (plate tank correctly tuned), replace the 1st oscillator tube, V314.

3. Meter the receiver filament voltage at the power supply. When the source voltage is within proper limits, the filament voltage should fall within ± 10% of the values given below.

Application	Meter Connected Between	Nominal Reading on 0-3 V Scale of 20,000 ohm/volt meter	Corrected Meter Reading or A-C Meter Reading
6 volt Mobile	Imp.V (J506 and GND (J508)	0.98 volts d-c	5.9 volts d-c
12 volt Mobile	Imp.V (J506 and (J508)	2.1 volts d-c	12.9 volts d-c
117 volt Station	J510-6 and J510-7		6.3 volts a-c

4. Meter the Receiver B-plus at the power supply. When the source voltage is within proper limits the Receiver B-plus voltage should fall within ± 10% of the values given below.

Application	Measured Between	Reading on 0-3 volt Scale of 20,000 ohm/volt meter	Corrected Meter Reading
6 & 12 V Mobile	LB+ (J505) and GND (J508)	2.0 volts	200 volts
117 Volt Station		2.0 volts	200 volts

5. If all metering voltages are within tolerance and the Second Limiter noise current is out of tolerance, replace the tubes in the multipliers and RF amplifiers. If tube replacement does not return the Second Limiter current to their nominal limits, check the front end tuning as described in Bench Alignment Procedures.

CIRCUIT ANALYSIS

Receiver Type ER-25-C and ER-25-D employs a double-conversion superheterodyne circuit with Automatic Gain Control on the first RF amplifier. RF selectivity is accomplished ahead of the RF stage.

RF signals received on the antenna are fed to the first RF grid through a double tuned pre-selector transformer circuit (T336). This circuit correctly terminates the 50 ohm transmission line and extracts maximum input power from the antenna system. It also steps up the input voltage as RF is transferred from the antenna to the 1st grid. Since the double tuned circuits of the pre-selector are very high in Q factor, and very selective, accurate tuning to the desired signal is required. The first RF Amplifier tube is coupled to the grid of the 1st Converter (1/2 12AT7 low noise triode) by a double tuned high Q RF transformer. A high IF frequency of 8.7 megacycles is derived by injecting the necessary oscillator voltage to the grid of the 1st Converter.

Injection voltage originates from the first crystal frequency which is multiplied in the 12AT7 (V315) 12 times before injection at the converter. The crystal oscillator (Channel A) utilizes 1/2 of a 12AT7 (V314) and a tuned tank circuit Z301, in a Miller oscillator circuit. For two frequency applications, the second section of a V314 (1/2 12AT7) is utilized as the channel B crystal oscillator. Trimmer C352, across the crystal, makes it possible to shift the frequency of the crystal oscillator slightly so as to adjust it to the systems channel frequency. This method of shifting the crystal frequency eliminates the necessity of heated ovens for crystals in equipment exposed to the range of ambient temperatures normally encountered in land mobile services, since the basic temperature stability of the crystal is not impaired or affected. The Multiplier plate circuit transformers T310 and 311 are double tuned high Q transformers which adequately dispose of unwanted frequencies from the crystal multiplier. The second section of the 12AT7 (V315) multiplies the crystal frequency by 3, while the first section quadruples its input -- thus effecting a 1 x 12 multiplier before injection to the first Converter. The first section of the 12AT7 1st Converter (V302) is used as a delay diode on the Automatic Gain Control voltage, derived from the 1st Limiter grid and applied to the control grid of the 6AK5 RF Amplifier (V301). The amount of delay voltage is adjusted so that no AGC voltage is present on the RF Amplifier grid for relatively weak input signals.

The 8.7 megacycle high IF signal derived from the 1st Converter is fed through a four-circuit IF transformer (T334) to the second converter. This arrangement of four tuned circuits, between the two converter stages gives maximum protection against receiver desensitization. All of the couplings in the transformer are set at critical and can, therefore, be peaked by observing the first limiter current while a weak input signal is used at the input of the receiver. The output of the selective 8.7 megacycle high IF amplifier stage is fed to the grid of the second converter (V304-1/2 12AT7), mixed with the 2nd oscillator injection frequency of 8410 kilocycles producing a 290 kilocycle beat frequency or low IF frequency.

One six and one double tuned IF transformer produces the selectivity required for adjacent channel operation, while permitting full modulation acceptance on weak signals. The first low IF transformer consists of six resonant circuits, alternately inductive and capacitively coupled to each other. The coupling may be easily reduced to yield the proper selectivity for narrow band operation. The output signal of the 2nd low IF Amplifier is fed through the double tuned IF transformer in its plate circuit to the grid of a 6BH6 1st limiter (V307).

The 1st and 2nd limiter tubes (V307 and V308) are coupled by L306 and L307, whereby sufficient gain for good limiting action is provided. The output of the 2nd limiter goes directly to the discriminator where the audio voltages are recovered from the FM signal.

The rectified output of the Foster-Seely type discriminator serves two or three purposes: The audio portion of the signal is fed to the 6AQ5 Audio Amplifier through a de-emphasis network composed of R335, R333, R336, C336 and R337. A rheostat volume control, external to the receiver chassis, is introduced in the circuit at the junction of R337 and C336.

Under no carrier conditions, noise, a good portion of which may be due to shop effect and thermal agitation in the first stages of the receiver, is amplified and would ordinarily appear at the loudspeaker as audio noise. To eliminate this, a squelch circuit is introduced. To understand the operation of the squelch circuit, assume no signal is received. The higher frequency components of the noise (above voice frequency range) introduced are coupled to the grid of the noise amplifier. The noise signal is amplified and applied to the noise rectifier, which is a voltage doubler. The rectified noise voltage is divided by a resistor network, and a portion of the voltage developed is applied to the control grid of the squelch tube (V312-2), driving the grid positive with respect to the cathode. This causes plate current to flow, which, in turn, causes a larger drop across the plate resistor. Since this resistor is connected to the grid of the Audio Amplifier, the audio amplifier is biased negatively until no plate current flows. Thus, no amplification of the noise takes place and the output does not appear at the loudspeaker.

When a signal is received, the limiters become saturated, noise no longer reaches the discriminator or noise amplifiers, and the positive voltage on the grid of the squelch amplifier disappears. Negative voltage (with respect to ground) from the 2nd limiter is introduced into the noise rectifier circuit, effecting a negative potential at the grid of the squelch amplifier control grid and thus cutting the tube off and allowing the bias voltage of the first audio tube to return to normal.

Audio voltages from the transmitter signal are effectively blocked from the noise amplifier due to the capacitors selected. These capacitors which couple the noise signal to the noise amplifier grid and then to the noise rectifier, are of small values which discriminate against the low audio frequencies so that the audio signal is not amplified or rectified to any appreciable extent by the noise amplifier.

Adjustment of the squelch circuit, in order to allow the smallest possible audio signal to render the receiver operative, may be made by a squelch control which is located external to the receiver chassis. This control consists of a rheostat electrically tied to the cathode circuit of the noise amplifier, which varies the gain of the tube by varying its bias.

In operating the equipment, it will be noticed that the squelch does not close immediately when the carrier goes off the air at the end of transmission. If the unit is in a noisy area, a short "burst" of noise will be heard in the loudspeaker at the end of a transmission. The duration of noise is determined by the time constant established by capacitors C345, C346 and resistor R345. If desired, the duration of the noise signal that breaks through can be shortened considerably by removing capacitor C345. It must be remembered, however, that if this time constant is reduced, the weak signals found in the fringe area will be harder to understand since the squelch circuit will react very quickly to variations in signal strength. If the unit is to work in an area where the signals are always strong, the time constant can be reduced with no appreciable effect on intelligibility or operation of the receiver.

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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BENCH ALIGNMENT PROCEDURE
FOR
RECEIVER MODELS 4ER25C1,2,11,12 AND
4ER25D1,2,11,12

GENERAL

The following instructions cover the procedure for completely aligning the Receiver. Whenever a stage has been tampered with, misaligned or modified, etc., follow the procedure outlined in this instruction. Instructions are also provided at the end of this instruction for converting wide-band Receiver Type ER-25-D for narrow-band operation.

ALIGNMENT USING SERVICE OUTLINE

The Simplified Alignment Procedure found in the Service Outline for the Receiver may be used if only the oscillator, multiplier, limiter or the secondary of the discriminator need retuning.

METHODS OF BENCH ALIGNMENT

Most of the stages in this receiver are designed for either loose or critical coupling and can be tuned by simple peaking methods. The 1st and 2nd IF's (T324 or T318, and T335) are overcoupled and must be tuned by the resistor loading method (best) or the peak and dip method.

1. Peaking Method:

An RF Signal of the proper frequency is fed to a loosely or critically coupled stage and the stage is then adjusted for maximum meter reading at its output.

2. Discriminator Adjustment Method:

An unmodulated RF signal of the proper frequency (i.e., 290-kc) ± 10-kc is applied to the discriminator stage. The signal source should be of a constant amplitude over this ±10-kc deviation. The primary tuning slug (bottom of transformer) is adjusted to obtain equal plus and minus voltages for ± 10-kc deviation. At -10 kc the voltage is negative and at +10 kc the voltage is positive.

3. Resistor Loading Method:

An RF signal of the proper frequency is fed to an overcoupled stage. Placing the proper load resistors across the coils makes the coils cricitally coupled, so that they can be tuned by a simple peaking procedure. After peaking,the resistor loads are removed, returning the coils to normal (overcoupled).

4. Peak and Dip Method:

An RF signal of the proper frequency is fed to an overcoupled stage. The first coil is adjusted for maximum, while the second coil is shorted out. The short is removed and then placed on the third coil, while the second coil is tuned for minimum. The remaining coils are also shorted and alternately peaked and dipped. The metering is done across the first coil during the entire procedure.

PRELIMINARY OPERATIONS

Warmup

The receiver should be allowed to warm up for 5 minutes or more before tuning.

The signal generator may require as much as a half hour for warmup. See individual signal generator manual for recommended warmup.

Voltage

Check for proper battery or supply voltage (6.6, 13.2 or 26.4 volts d-c or 117 volts a-c).

Discriminator Zero

During the entire alignment, the generator frequency must be checked every few minutes for zero discriminator (after the discriminator has been correctly set at 290-kc). The 290-kc signal should just saturate the second limiter grid. The 290-kc signal can be inserted at any stage ahead of the stage being tuned.

Crystal oven cycling, causing a slight frequency variation with temperature (.0005% of crystal frequency), can be observed when setting the discriminator for zero. This same crystal oven cycling is also present on the transmitter. When setting for discriminator zero, this cycling can be taken into account by first observing the maximum meter variation and then setting zero for an average of this variation.

Signal Generator Connections

Signals from the signal generator should be applied through a .01-mfd capacitor for all the procedures except when applying the signal to the antenna jack. The leads from the capacitor should be as short as possible. Connect the generator ground probe as close to the point of signal input as possible.

Metering

Before using a 20,000 ohm-per-volt meter or VTVM for metering, make certain that the meter reads exactly zero for the position it is being used. Since adjustments are to be made within 1-4 microamperes of zero, it is very important that zero is accurately set.

RECEIVER SENSITIVITY

Noise Current

The 2nd Limiter noise current was 110 microamperes or more when shipped. No loss of receiver sensitivity will occur as tubes age, until the noise current drops below 60% at J303 (2nd Limiter grid). To check for normal gain, make certain that the antenna transformer and RF tanks are both peaked. Replace the antenna with a 50-ohm load resistor. A reading of 100-microamperes or more at the 2nd Limiter grid will indicate normal gain.

Stage Gains

As a means of checking stage gains, the signal levels given in Table 1 may be used. When applied at the points indicated, these signal levels will give a reading of 40 microamperes at the LIM-1 jack. A variation in readings greater than 2-to-1, indicates a possible source of trouble. High noise current in a set may interfere with proper measurement of the first three figures in this table, in which case, both the input and 1st Limiter current may be doubled or tripled to estimate performance. An input of 25,000 microvolts at the 1st Limiter grid will produce a reading of 40 microamperes at the LIM-2 jack.

TABLE 1

SIGNAL INPUT TO OBTAIN READING OF 40 MICROAMPS AT LIM-1 JACK

SIGNAL GENERATOR FREQUENCY	SIGNAL LEVEL IN MICROVOLTS (Approx.)	INPUT POINT
Receiver Frequency	4	RF grid (XV301-1)
8.70 Mc	35	1st Mixer grid (XV302-7).
290-Kc	60	2nd Mixer grid (XV304-2).
290-Kc	300	XV305-1
290-Kc	50,000	XV306-1

DISCRIMINATOR ALIGNMENT

EQUIPMENT REQUIRED

1. A non-metallic screwdriver.

2. A 0-3 volt d-c meter. (20,000 ohm-per-volt or VTVM) or a 0-100 microampere d-c meter (EX-1-C).

3. A 290-kc calibrated signal source. (Generator can be calibrated against the 290-kc signal present in another receiver which has not been tampered with).

PROCEDURE

1. Apply 290-kc ± .002% signal through .01-mfd capacitor to XV307-1. Use a signal strong enough to saturate the 2nd LIMiter grid.

2. Connect voltmeter between DISC jack (J304-orange) and ground.

3. Remove 8410-kc crystal (Y302) to prevent signals or noise from interfering with alignment.

4. Tune top slug (secondary) of discriminator transformer (T308) for zero reading on voltmeter.

5. Turn signal generator dial to 280-kc and note value of negative voltage on meter.

6. Turn signal generator dial to 300-kc and note value of positive voltage on meter.

7. Positive and negative voltages noted in steps 4 and 5 must be equal in amplitude. If not equal, tune bottom slug (primary) of discriminator transformer (T308) until the voltages are equally positive and negative within 0.3-volt on a VTVM or 0.1-volt on a 0-3 voltmeter. Adjusting the primary slug will require that the secondary be readjusted.

IF ALIGNMENT

8.7-MC IF TRANSFORMER (T334)

Equipment Required:

1. A non-metallic screwdriver.
2. A 0-3 volt d-c meter or a 0-100 microampere d-c meter.
3. An 8.7-MC signal source.

Procedure:

1. Apply an 8.7-Mc signal through a .01-mfd capacitor to XV302-7. Do not saturate the 1st Limiter. Keep signal zeroed to discriminator (Remove the 1st Osc. crystal).

2. Connect meter between LIM-1 jack (J302-green) and ground.

3. Leave the 8410-kc crystal (Y302) in its socket.

4. Tune the four coils of the transformer for maximum meter reading.

Discriminator Idling:

When a set has been completely and properly aligned, the no-signal reading of the discriminator (noise only) should be within ± 0.6-volt of zero when read on a VTVM. This is equivalent to 10.0-microamperes on a 2400-ohm microammeter or 0.2-volt on a 20,000-ohm-per-volt meter. Whenever a receiver has been phase tuned (see section on Phase Tuning), the discriminator idling is determined by the phase tuning adjustment. For a properly aligned receiver, the discriminator idling should not exceed 0.6 to 0.9 volt, as read on a VTVM.

290-KC IF TRANSFORMER (T335)

Equipment Required:

1. A non-metallic screwdriver.
2. A 0-100 microampere d-c meter (G-E Type EX-1-C).
3. A 290-kc calibrated signal source.

Procedure:

1. Apply a 290-kc signal through a .01-mfd capacitor to XV305-1.

2. Connect meter between LIM-1 jack (J302-green) and ground.

3. Remove 8410-kc crystal (Y302) to prevent signals or noise from interfering with alignment.

4. Load the primary by soldering a 39,000-ohm, 1/2-watt resistor across the transformer leads.

5. Tune the secondary of the transformer for maximum reading at the LIM-1 jack.

6. Load the secondary by soldering a 22,000-ohm, 1/2-watt resistor across the transformer leads. Do not remove the primary load.

7. Tune the primary of the transformer for maximum reading at the LIM-1 jack.

8. Remove both loading resistors.

9. Replace the 8410-kc crystal (Y302).

290-KC IF TRANSFORMERS (T324 and T318)

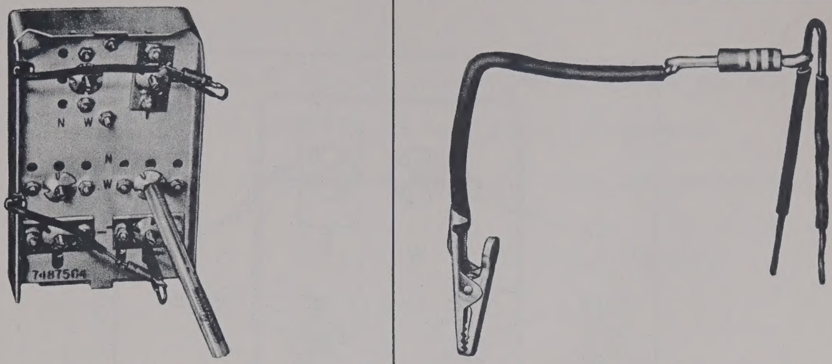
Equipment Required:

1. A non-metallic screwdriver.

2. A 0-100 microampere d-c meter (G-E Type EX-1-C).

3. A 290-kc signal source.

4. Two load resistor assemblies, made up as shown in Fig. 1, if resistor loading method is to be used. 22,000-ohm resistors are recommended for a wide-band transformer (T324) and 39,000-ohm resistors are recommended for a narrow-band transformer (T318).



LOADING RESISTOR ASSEMBLY

MATERIAL

1/4 watt resistor, common bobbypin, insulating sleeving for bobbypin, alligator clip and a 3-inch piece of test lead.

CONSTRUCTION

Flatten the tips of the bobbypin together so that they are flush, then spread the bobbypin legs out to form a "V". This is done so that when the bobbypin is inserted into the pin jack it will spread out and bind in the test jack for good electrical contact. Solder one lead of the resistor to one leg of the bobbypin near its loop, and solder the other resistor lead to the test lead terminated in an alligator clip. Clean and tin the bobbypin ends to prevent corrosion and to assure good electrical contact. Slide insulating sleeving over the bobbypin ends to prevent shorting. Sleeving should be tight enough to prevent slipping.

USING LOAD RESISTOR ASSEMBLY

Fasten the alligator clip to the chassis and insert the bobbypin into the pin jack. Two loading resistor assemblies can be used simultaneously while peaking coils in the six coil transformer assembly.

(RC-444A)

FIG. 1

Resistor Loading Procedure (Best):

1. Apply a 290-kc signal through a .01-mfd capacitor to XV304-2, when aligning the 1st LO IF.

2. Connect meter between LIM-1 jack (J302-green) and ground.

3. Refer to Fig. 1 for proper use of load resistors and Fig. 2 for location of coils and loading jacks.

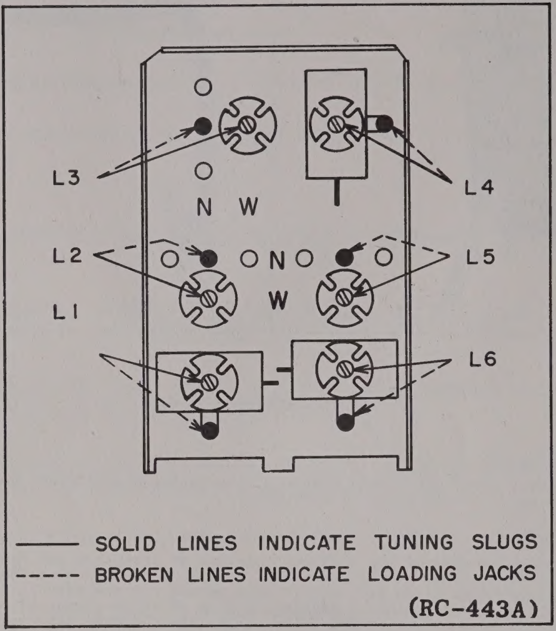

L3
L4
N W
L2
L5
L1
W
L6
SOLID LINES INDICATE TUNING SLUGS
BROKEN LINES INDICATE LOADING JACKS
(RC-443A)

FIG. 2 Location of Tuning Slugs and Jacks, 290-kc IF Transformers - T324 and T318.

4. Load L-2 and peak L1.

5. Remove load from L-2. Load L1 and L-3 and peak L-2.

6. Remove loads from L1 and L-3. Load L-2 and L-4. Peak L-3.

7. Remove loads from L2 and L-4. Load L-3 and L-5. Peak L-4.

8. Remove loads from L-3 and L-5. Load L-4 and L-6. Peak L-5.

9. Remove loads from L-4 and L-6. Load L-5 and peak L-6.

10. Remove load resistor from L-5.

11. Repeat steps 4 to 10 to insure proper alignment.

Peak and Dip Procedure:

1. Locate tuning slugs and pin jacks as shown on Fig. 2.

2. Connect meter between L1 pin jack and ground.

3. Short coils with jumper wire and tune as in following table:

Short	Tune	Meter Reading
L-2	L1	Peak
L-3	L-2	Dip
L-4	L-3	Peak
L-5	L-4	Dip
L-6	L-5	Peak
None	L-6	Dip

FRONT END TUNING

The frequency of the receiver may be changed by replacing the 1st oscillator crystal and retuning the oscillator, multiplier and RF stages as described below.

If the frequency is changed by only one channel (60 kilocycles), the multiplier retuning can usually be omitted. The RF PLATE tuning transformer T332 and the antenna pre-selector, however, should always be retouched as they contain very selective circuits. If the receiver needs to be completely retuned, use the procedure outlined in the fore-going portion of this instruction.

Equipment required:

1. A non-metallic screwdriver.

2. A microammeter with a 0-50 and 0-500 microampere scales (General Electric Test Set Type EX-1-C) or a 20,000 ohm-per-volt voltmeter with a 0-3 volt scale.

3. A crystal of the proper frequency for the first oscillator (between 11.27 and 13.77 megacycles).

4. A signal generator with a 144-174 megacycle range, such as Measurements Corp. Model 80, General Radio 1021AV, or a Boonton 202-C. If a signal generator is not available when tuning the receiver in the field, connect the proper antenna to the receiver and transmit a weak signal from the transmitter with which the receiver is intended to operate.

Procedure:

To change frequency or align the RF and antenna stages, proceed as follows. Meter readings are between the jack indicated and ground.

1. Turn the receiver on and allow it to warm up for five minutes. Be sure that the battery or supply voltage is normal (6.6 or 13.2 volts d-c or 117 volts a-c.)

2. Insert the new crystal in the First Oscillator crystal socket. This is an octal socket and care must be exercised to place the crystal in the correct position.

3. Connect the 0-500 microammeter or the 0-3 volt meter to the OSC-1 jack, J305 (green-negative).

4. Tune the oscillator tank coil, Z301 for maximum oscillator grid meter indication. If there is any doubt about being on the correct peak, turn the adjustment fully counterclockwise, then clockwise to the first peak. Note the reading and turn the iron core counterclockwise until the meter reads 80% of the maximum grid metering voltage or 1.3 volts whichever is lower. A minimum of about 1.1 volts should be obtained after tuning for 80% of the maximum with a standard supply voltage of 6.6 for 13.2 volts d-c or 117 volts a-c to the power supply. A 0-500 ua meter may be used for these measurements. However, not all microammeters will give the same reading depending on the internal resistance of the meter. For EX-1-C meter or 0-500 microampere range, the reading equivalent to 1.3 volts on the 0-3 v meter is 365 microamperes. Other multimeters may read as much as two to one lower.

5. Connect a microammeter or a 0-3 volt meter to the MULT jack, J306 (green-negative) and peak the top and bottom slugs of T310. This current should be 30 microamperes (.7 volts on a 0-3 volt meter) or more. Since the value of the shunt resistor is much higher in this circuit, the correct reading will be more than 30 microamperes on any multimeter or microammeter.

CAUTION

The recessed adjustment of ceramic trimmer capacitor C1 is in the B-plus circuit of multiplier transformer T311 or T326 and protected by a rubber grommet. Use caution around this capacitor.

6. Set trimmers of T311 (or T326) to approximately the correct position. At high end of receiver range (148 MC on 4ER25C, D1 or 11 or 174 MC on 4ER25C, D2 or 12) trimmer should be set at MIN (use dot of solder on ceramic part of rotor as a pointer). At low end of receiver range (144 MC on 4ER25C, D1 or 11 or 152 MC on 4ER25C, D2 or 12) trimmer should be set at maximum. Adjust proportionately for mid-frequencies.

7. Connect signal generator to pin 8 of XV302. Using maximum generator output, zero generator to discriminator. This zeroing should coincide with an increase in LIM-1 meter indication.

8. Reduce the signal generator output until the LIM-1 meter indicates below saturation, but above noise. Peak both trimmers of T311 (T326).

9. Move the signal generator to pin 1 of XV301. With the generator adjusted to zero discriminator and output below limiting, peak T332 (T333) trimmers marked RF on chassis. It is suggested that the grid circuit of the 1st Converter (C385) be tuned to resonance first, followed by the RF Amplifier plate circuit (C305).

10. Move the signal generator to the antenna jack (J1 on antenna transformer).

11. With the meter at LIM-1 (J302) and signal applied, peak the antenna transformer (T336 or T337) trimmer C8 and C9 (top and bottom of housing). Always peak trimmer C9 (bottom of housing) first and follow by peaking trimmer C8 (top of housing). Once peaked it is suggested that trimmers C9 and C8 of T336 or T337 be tuned for maximum quieting. Depending upon the receiver operating frequency, maximum LIM-1 current and maximum quieting may not occur together. Where this is the case, always tune for maximum quieting as noted on an output meter or in its absence by speaker response while keeping input signal level from signal generator low.

12. ReCheck the RF and multiplier tuning. If possible monitor an unmodulated signal from a system transmitter for this check.

A) Recheck the adjustment of the OSC-1 trimmer (C352) for zero discriminator.

B) With a meter connected to J302, LIM-1 recheck the tuning of C8 and C9 of T336 (T337).

C) Recheck the setting of Z301-L1 (meter connected to J305, OSC) for 1.3 volt reading.

D) With meter connected to LIM-1, J302, recheck the peaking of T310, T311, (T326) and T332 (T333).

PHASE TUNING

Phase Tuning is very effective in improving receiver performance on noise having steep wave fronts (e.g. - ignition noise). The Phase Tuning procedure outlined below can only be used when the following conditions are met:

1. The Receiver must be properly aligned and have a sensitivity of 20 db of quieting for 0.4-uv input.

2. The discriminator reading on both noise and signal must be no greater than ± 0.2-volt on a d-c meter (20,000 ohms-per-volt).

Equipment Required:

1. A non-metallic screwdriver.

2. A 0-3 volt d-c meter or a 0-100 microampere d-c meter.

3. A 144 to 174 Mc signal source (signal generator or station transmitter).

4. A noise generator constructed as shown in Fig. 3.

Procedure:

1. Connect the antenna or signal generator, and the output of the noise generator to the Receiver antenna input through a "T" connector. If a noise generator is not available, phase tune the receiver in the vehicle, with the engine running and with the radio connected to the mobile antenna. Since generator noise cannot be phase tuned, be sure that the generator noise has been adequately suppressed at its source.

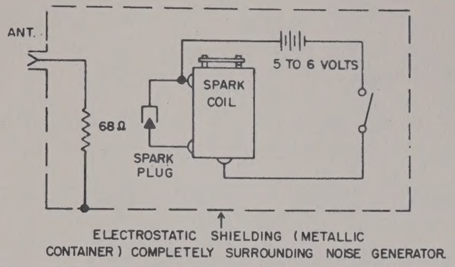
2. Connect meter between LIM-1 jack (J302-green) and ground.

3. Radiate a weak on-frequency signal enough to quiet the receiver about 20 to 25-db (40 to 70 microamperes at the LIM-1 jack).

4. Turn the noise generator switch to "ON".

5. Connect meter between DISC jack (J304-orange) and ground.

6. Tune L4 or L1 of T334 (one-quarter turn in either direction for a noise null while on zero discriminator).


ANT.
5 TO 6 VOLTS
SPARK COIL
68 Ω
SPARK PLUG
ELECTROSTATIC SHIELDING (METALLIC CONTAINER) COMPLETELY SURROUNDING NOISE GENERATOR.

PARTS LIST

1 - SPARK COIL, FORD MODEL T (AVAILABLE FROM SEARS ROEBUCK & CO.)
1 - SPARK PLUG (POINTS SPREAD OUT TO APPROXIMATELY 1/16")
2 - DRY CELLS, BURGESS TYPE F4H OR EQUIVALENT. (FOR 6 VOLT)
1 - SPST TOGGLE SWITCH
1 - 68 Ω RESISTOR
1 - PHONO JACK

RC-445A

FIG. 3 - Noise Generator

7. If a noise null cannot be obtained, return the slugs to their original position. (maximum meter reading at LIM-1 jack), and proceed as follows:

> Tune L4 and L6 of T324 or T318 for best noise null but do not turn slugs any more than one-quarter turn.

8. Recheck phase tuning in the high IF.

9. The loss of 1st LIMiter current should not exceed 5.0 microamperes as the result of phase tuning (an indication of mis-alignment of the low IF).

NARROW-BAND CONVERSION

This procedure describes how to convert a Type ER-25-D Receiver for narrow-band operation. Basically, the conversion involves changing the coupling in the 6-coil Lo-IF transformer, clipping out a coupling capacitor, and changing two resistors. Parts for making the conversion may be obtained by ordering Conversion Kit PL-4032043-G2. For users who desire the conversion without making it themselves, a narrow-band 6-coil Lo-IF transformer is available on an exchange basis. This transformer may be obtained by ordering PL-7487564-G5. Also specify if using a one or two frequency Transmitter.

PARTS REQUIRED

Number Required	Description	G-E Drawing and Part Number
1	Capacitor, ceramic: insulated, temp. compensating; 5.5 mmfd ± 0.10 mmfd, 500 V d-c W, -80 ±60 temp. coef.	B-7488184-P9
1	Capacitor, ceramic: insulated, temp. Compensating; 2.2 mmfd ± 0.10 mmfd, 500 V d-c W, -80 ± 120 temp. coef.	B-7488184-P8
1	Resistor, composition: 0.33 megohm ± 10%, 1/2 w.	C-3R77-P334K
2	Loading Resistors, composition: 39,000 ohms ±10%, 1/2 w.	C-3R77-P393K

PROCEDURE

1. Six-coil LO-IF transformer T324 should be either converted to narrow band, as described in this step, or replaced by a pre-tuned transformer (PL-7487564-G5) ordered from your G-E Service Shop or your nearest District Sales Office.

(a) Disconnect the leads from transformer T324 and remove the transformer from the receiver chassis.

(b) Remove the outside cover and the three small inner shields from T324.

(c) Clip out and discard C3, the 7.25-mmfd coupling capacitor between L2 and L3; and C6, the 6.0-mmfd coupling capacitor between L4 and L5. See Fig. 4.

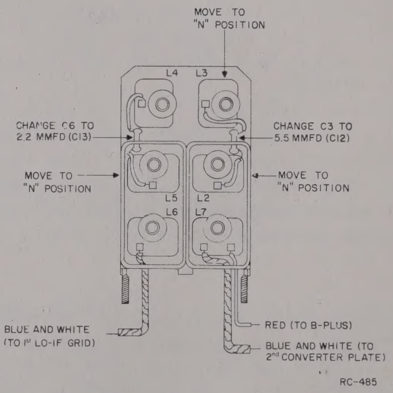

MOVE TO "N" POSITION
L4
L3
CHANGE C6 TO 2.2 MMFD (C13)
CHANGE C3 TO 5.5 MMFD (C12)
MOVE TO "N" POSITION
MOVE TO "N" POSITION
L5
L2
L6
L7
BLUE AND WHITE (TO 1st LO-IF GRID)
RED (TO B-PLUS)
BLUE AND WHITE (TO 2nd CONVERTER PLATE)
RC-485

Fig. 4 - Narrow-Band Conversion of 6-Coil Transformer

(d) Remove the mounting hardware (two #4 nuts and lockwashers) from coil L2 and remove the coil assembly. Then, while holding the slug inside the can, remove the tension nut from the top with a small screwdriver. Move the slug from the "W" hole to the "N" hole and replace the tension nut back on the slug.

(e) Solder one end of 5.5-mmfd capacitor C12 to the same terminal of L2 from which C3 was removed in Step 3. Leave a lead length of one inch, covered by sleeving.

(f) Rotate the coil assembly 180° (to provide mechanical fit) and re-install it over the slug in the "N" holes.

(g) Remove the coil assembly and slug of L3 and re-install them in the "N" holes, following the same procedure used with L2.

(h) Solder the other end of the 5.5-mmfd capacitor to the same terminal of L3 from which C3 was clipped in Step 3. Use sleeving on lead.

(i) Remove the coil assembly and slug of L5 and re-install them in the "N" holes, following the same procedure used with L2.

(j) Solder one end of 2.2-mmfd capacitor C13 (using sleeving) to the same terminal of L5 from which C6 was removed in Step 3. Leave a lead length of one inch, covered by sleeving.

(k) Solder the other end of the 2.2-mmfd capacitor to the same terminal of L4 from which C6 was removed. Use sleeving on the lead.

(l) Replace the three inside shield covers on the transformer, remount it on the receiver chassis, and resolder the connections to T324:

Red Wire to TB12-1.
Blue & White Wire (plate) to TB12-2.
Blue & White Wire (grid) to XV305-1.

2. Make the following component changes:

(a) Solder a 330,000-ohm resistor from TB8-20 to TB8-7, in parallel with R386 (470K-ohm noise rectifier plate resistor).

(b) Clip out and discard R333 (33K-ohm resistor) from VOL. CONTROL HI to ground.

(c) Clip out and discard R406 (22K-ohm 2nd converter plate resistor).

(d) Clip out and discard C402 (3.0-mmfd capacitor across two-coil low-IF transformer T335).

3. Change the Receiver Model Number from 4ER25D1, 2, 11 or 12 to 4ER25C1, 2, 11 or 12, respectively. T324 should now be referred to as T318 (PL-7489565-G5).

4. Check the alignment of 6-coil transformer T318 and 2-coil transformer T335, as described earlier in this instruction. Replace the outside cover on T318.

5. If ignition noise interference is present after converting the receiver, it is recommended that the receiver be phase tuned. (See preceding section).

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hole to the "N" hole and replace the tension nut back on the slug.

(e) Solder one end of 5.5-mmfd capacitor C12 to the same terminal of L2 from which C3 was removed in Step 3. Leave a lead length of one inch, covered by sleeving.

(f) Rotate the coil assembly 180° (to provide mechanical fit) and re-install it over the slug in the "N" holes.

(g) Remove the coil assembly and slug of L3 and re-install them in the "N" holes, following the same procedure used with L2.

(h) Solder the other end of the 5.5-mmfd capacitor to the same terminal of L3 from which C3 was clipped in Step 3. Use sleeving on lead.

(i) Remove the coil assembly and slug of L5 and re-install them in the "N" holes, following the same procedure used with L2.

(j) Solder one end of 2.2-mmfd capacitor C13 (using sleeving) to the same terminal of L5 from which C6 was removed in Step 3. Leave a lead length of one inch, covered by sleeving.

(k) Solder the other end of the 2.2-mmfd capacitor to the same terminal of L4 from which C6 was removed. Use sleeving on the lead.

(l) Replace the three inside shield covers on the transformer, remount it on the receiver chassis, and resolder the connections to T324:

Red Wire to TB12-1.
Blue & White Wire (plate) to TB12-2.
Blue & White Wire (grid) to XV305-1.

2. Make the following component changes:

(a) Solder a 330,000-ohm resistor from TB8-20 to TB8-7, in parallel with R386 (470K-ohm noise rectifier plate resistor).

(b) Clip out and discard R333 (33K-ohm resistor) from VOL. CONTROL HI to ground.

(c) Clip out and discard R406 (22K-ohm 2nd converter plate resistor).

(d) Clip out and discard C402 (3.0-mmfd capacitor across two-coil low-IF transformer T335).

3. Change the Receiver Model Number from 4ER25D1, 2, 11 or 12 to 4ER25C1, 2, 11 or 12, respectively. T324 should now be referred to as T318 (PL-7489565-G5).

4. Check the alignment of 6-coil transformer T318 and 2-coil transformer T335, as described earlier in this instruction. Replace the outside cover on T318.

5. If ignition noise interference is present after converting the receiver, it is recommended that the receiver be phase tuned. (See preceding section).

6 1

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545776

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5 1 4

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537240

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120.87906

6822.2

18) 122.8

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